4555

SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM

SEVEN YEAR RESEARCH PROGRAM

DRAFT BUDGET AND WORK PLAN

FISCAL YEAR 1998

PREPARED FOR
SJRRIP COORDINATION COMMITTEE

PREPARED BY
SJRRIP BIOLOGY COMMITTEE

10 March 1998

PROJECT INDEX

PREFACE

1998 is a transitional year for the San Juan Recovery Implementation plan. The initial seven years of research has been completed and results are being summarized and final reports prepared. At the same time, critical research/recovery elements need to continue to maintain the goals of the program. To avoid conflict of synthesizing and summarizing past findings with on-going field work, priorities must be set. Each individual research element includes substantial budget for synthesis and integration, allowing adequate staff time to complete these tasks. Therefore, the priority of each research element is (1) completion of analysis necessary to develop flow recommendations, (2) completion of final reports summarizing the seven-year research period and (3) field studies for continuation of research/recovery efforts. Due to timing, of key field data collection elements, field work will commence prior to completion of the final reports, but budget nor time will be compromised such that the final reports cannot be completed by the end of the fiscal year.

There presently exists a budget balance, provided winter squawfish tracking is not funded, that will be expended at the best discretion of the Biology Committee, with a report to the coordination committee on the nature of the expenditure.

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holding and transport, and receiving waters for channel catfish mechanically removed from the San Juan River. Initial removal and transplantation efforts will begin during 1998 at two sites to be determined. Site selection will be based upon vehicular access to holding pens, demonstrated high abundance of channel catfish in reaches considered important to native species, and administrative clearance for removal and relocation of live channel catfish.

Participation will continue in data integration efforts to incorporate 1997 data, produce a final report and formulate flow recommendations for reoperation of Navajo Dam and Reservoir.

Budget:

Personnel:	
Mechanical removal/main channel monitoring	$ 28,800
Channel catfish translocation coordination/mgt. plan	$ 6,000
Channel catfish translocation (3 reaches)	$ 17,000
Integration/final report	$ 4,000
Subtotal	$ 55,800
Travel/per diem:	
Mechanical removal/main channel monitoring	$ 3,300
Translocation	$ 2,400
Integration/final report	$ 1,000
Subtotal	$ 6,700
Equipment and supplies	
Mechanical removal/main channel monitoring	$ 1,000
Translocation	$ 1,500
Integration/final report	$ 500
Subtotal	$ 3,000
TOTAL	**$ 65,500**

Funding Sources:

USBR	$ 400,000
BIA contract for Aerial Photo	15,000
BIA/NIIP	121,000
BIA/Albuquerque	50,000
USFWS	126,500
Southern Ute Tribe	21,765
Total Available	**$ 734,265**
Balance (Shortfall) without winter tracking of Squawfish	17,260
Balance (Shortfall) for all projects	(41,350)

Possible Funding Sources:

Jicarilla Apache	8,000
Total Potential	**$ 8,000**
Balance (Shortfall) without winter tracking of Squawfish	26,495
Balance (Shortfall) for all projects	(32,115)

III. Other Funded Research and Management Projects

BIA Funded

Data Integration	$ 73,840
River Channel Dynamics	126,815
Habitat Mapping and Resource Utilization	143,128
Flow/Habitat Modeling	54,870
River Operation Modeling	41,340
Water Temperature Monitoring	5,293
GIS Based Integrated Database Maintenance	25,464
Population Goals for the San Juan River Long Range Plan	110,000
BIA Total	$580,750

USBR Funded

Hydrologic Modeling	86,557
USBR Total	$86,557
GRAND TOTAL (Presently funded)	**$1,384,312**
GRAND TOTAL (Fully Funded)	**$1,442,922**

ADULT RARE FISH MONITORING
FISCAL YEAR 1998 PROJECT PROPOSAL

Principal Investigators: Dale Ryden and Frank Pfeifer
U. S. Fish and Wildlife Service, Grand Junction, CO
Contact at (970) 245-9319

Background:

Studies performed before 1991 documented a native San Juan River fish fauna of eight species, including Colorado squawfish, razorback sucker, and roundtail chub and provided baseline information on distribution and abundance of native and introduced fish species in the San Juan River. Adult monitoring studies performed from 1991 to 1997 refined this baseline data and provided data on specific habitat usage by rare fish species. Adult monitoring has proven to be the most effective tool for monitoring populations of stocked razorback sucker and recently stocked adult Colorado squawfish. In addition adult monitoring has recently captured numerous stocked, early life stage Colorado squawfish. Information gathered during adult monitoring also aided in the selection of specific sites for detailed hydrologic measurements and larval drift sampling. Integration of adult fish community monitoring data with data from Colorado squawfish macro habitat studies, razorback sucker experimental stocking studies, tributary and secondary channel studies, fish health studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, helped provide data to make flow recommendations for reoperation of Navajo Reservoir.

To date twenty-five intensive electro fishing surveys conducted from 1991 to 1996 have expanded our baseline knowledge on the distribution and abundance of the San Juan River fish community. During these studies, nineteen wild Colorado squawfish were collected and PIT-tagged; 13 of the 19 Colorado squawfish were radio-tagged. In addition, 10 adult and 39 juvenile, experimentally-stocked Colorado squawfish have been recaptured. Twenty-two roundtail chub were collected, 18 of these were PIT-tagged. No wild razorback sucker were collected, however 62 of 64 recaptured, stocked razorback sucker have been recaptured during adult monitoring. FLOY-tagged native suckers have yielded data about the movement of these species in relation to four instream diversion structures in the area of Farmington, New Mexico.

The need for a long-term, standardized monitoring program, such as the adult monitoring study is addressed in objective 5.7.1, a Milestone in the San Juan River Long Range Plan. Additionally, future monitoring will help determine fish community response to reoperation flows from Navajo Dam (objective 5.2.10), as well as monitoring both wild and augmented populations of Colorado squawfish and razorback sucker (objective 5.3.9). Further monitoring of experimentally-stocked, adult Colorado squawfish and FLOY-tagged native suckers will help address objective 5.2.9,

specifically 5.2.9.1 by examining the movements of these fish in relation to the diversion structures near Farmington, New Mexico.

Adult monitoring will continue with five trips in 1998, to measure fish community response to reoperation flows from Navajo Dam, monitor populations of experimentally-stocked Colorado squawfish and razorback sucker, and assess impacts of instream diversion structures to experimentally-stocked Colorado squawfish. In support of objective #5 below, nonnative fish removal will continue to be done on all adult monitoring trips. Sampling crews will consist of approximately 10-13 people. In support of objective #4 below, all fish collected in the Farmington to Hogback Diversion (New Mexico) reach will continue to be FLOY-tagged and monitored during 1998 sampling to continue to evaluate the impact of instream diversion structures in this reach of river on the movement of other native fish species. The study design for adult rare fish monitoring will be based upon adult fish community monitoring studies that were conducted from 1991-1997. However, the study design may be modified to fit the criteria for long-term monitoring of the San Juan River fish community. These criteria are being developed by a subcommittee of the San Juan River Biology Committee.

Objectives:

1.) Determine shifts in fish community structure, abundance and distribution, and length/weight frequencies under the reoperation flow regime.

2.) Monitor Colorado squawfish population trends (spawning and staging areas, habitat needs).

3.) Monitor experimentally stocked razorback sucker and Colorado squawfish (growth rates, dispersal patterns and habitat use).

4.) Continue evaluation of movement data and rare fish distribution to determine the extent to which current structures (dams, weirs, etc.) are impeding endangered fish movement. Time periods for this sampling will be pre-runoff, runoff, and post-runoff.

5.) Remove nonnative fish species which prey upon and compete with native fish species in the San Juan River.

6.) Integrate data obtained during 1991-1997 field research with other study elements for the purpose of making flow recommendations for the reoperation of Navajo Reservoir. Produce a final report for results and findings from 1991-1997 adult monitoring studies.

Methods:

Objectives 1-6: Five adult sampling trips will take place in 1998. The April, June, and July trips will be from Farmington, New Mexico to Hogback Diversion, New Mexico. In August, the river will be sampled from Mexican Hat to Clay Hills, Utah. The fall trip will sample from Hogback Diversion to Mexican Hat, Utah. Electro fishing will be the primary sampling technique, although seining and trammel netting may also be employed. Radio tracking will be conducted on all adult monitoring trips, as well as being coordinated with other research efforts throughout the year.

All fish collected will be enumerated by species, weighed, measured, and with the exception of nonnative fish species, returned alive to the river. All nonnative fish species will be removed from the river. Adult native suckers captured in the Farmington to Hogback Diversion, New Mexico reach of river will also be FLOY-tagged before release. Colorado squawfish, roundtail chub, and wild razorback sucker greater than 200 mm TL will be PIT-tagged. Wild, adult Colorado squawfish will be implanted with radio transmitters. Wild, adult razorback sucker will be removed from the river and taken into captivity for use in captive broodstock development.

Radio tag implantation and fish transport will follow the protocols attached to the San Juan River Seven Year Research Plan. Electro fishing will follow the methods set forth in the 1991-1992 adult monitoring annual report. Seining and trammel netting will be done where suitable habitat is available at the sampling crews' discretion. The Service will have the lead for these adult monitoring trips and other cooperating agencies will provide personnel and equipment as needed. Costs for cooperating agencies are not included in this budget.

Data integration is underway and is scheduled to culminate in the production of a flow recommendation report in December 1997. A final report for the 1991-1997 adult monitoring studies will be produced by summer 1998.

Budget FY-98:

Personnel Costs:	
1 GM-13 Supervisor	$ 5,000
1 GS-11 Fishery Biologist	$ 15,000
1 GS- 7 Administrative Support	$ 3,000
Data integration and final report costs	$ 5,000
Travel-Per Diem	$ 7,000
Equipment and Supplies	$ 7,000
Subtotal	$ 42,000
Service Administrative Overhead (19.00%)	$ 8,000
TOTAL	$ 50,000

EVALUATION OF STOCKED RAZORBACK SUCKER
FISCAL YEAR 1998 PROJECT PROPOSAL

Principal Investigators: Dale Ryden and Frank Pfeifer
U. S. Fish and Wildlife Service, Grand Junction, CO
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Background:

Razorback sucker are native to the San Juan River. At present this species is extremely rare in the San Juan. In order to gain information on habitat use, possible spawning areas, and survival and growth rates of hatchery-reared razorback sucker in the wild, it was necessary to experimentally stock a small number of fish. The information obtained during the experimental stocking study was used to develop and implement a plan for full-scale augmentation of this species in the San Juan River. Integration of razorback sucker experimental stocking data with data from adult fish community monitoring studies, Colorado squawfish macro habitat studies, contaminants studies, habitat mapping studies, and non-native species interaction studies, provided information essential to the development of flow recommendations for reoperation of Navajo Reservoir. Information obtained during the evaluation of stocked razorback sucker will help address objectives 5.1 through 5.5 in the San Juan River Long Range Plan.

In August 1997, a Five-Year Augmentation Plan for Razorback Sucker in the San Juan River was finalized. Stocking of razorback sucker from various sources into the San Juan River began in early September 1997. Between 3 and 19 September 1997, a total of 2,885 razorback sucker were stocked into the San Juan River at Hogback Diversion, New Mexico. The first group, stocked 3 September 1997, consisted of 1,027 fish that were collected from Lake Mohave as larval fish in 1996 and reared at Willow Beach National Fish Hatchery (NFH) in Arizona. The second group, stocked 17 September 1997, consisted of 227 fish that were progeny of various crosses between Green River adults between 1989 and 1995 and were reared at Ouray NFH. The last group, stocked 19 September 1997, consisted of 1,631 fish, were 1996 progeny of paired matings between San Juan River of Lake Powell adults and Colorado River arm of Lake Powell adults or Upper Colorado River adults. This last group was raised at various facilities in Grand Junction, Colorado. All stocked fish were PIT-tagged before release into the wild. Follow-up monitoring has begun and will continue on adult sampling trips. In addition, previously stocked razorback sucker that have been in the river for longer than one year will be implanted with radio transmitters and monitored for habitat use to see if their habitat use differs from that of newly stocked razorback sucker. Radio-tracking is also continuing with several razorback sucker that still have active tags from the experimental stocking study. Monitoring of these fish will continue in order to gain additional habitat use information and locate possible spawning areas. Opportunistic monitoring will also be done during other research trips throughout the year.

Objectives:

1.) Determine habitat use and needs, site preference, and movement patterns of hatchery-reared razorback sucker in the wild.

2.) Determine survival rates and growth rates of hatchery-reared, known-age razorback sucker in the wild.

3.) Determine whether hatchery-reared razorback sucker will recruit into the adult population and successfully spawn in the wild.

4.) Determine if hatchery-reared razorback sucker can lead researchers to their wild counterparts. If captured, wild razorback sucker will be brought into captivity and used to develop a captive broodstock for the San Juan River.

5.) Integrate data obtained during 1994-1997 field research with other study elements for the purpose of making flow recommendations for the reoperation of Navajo Reservoir. Produce a final report for results and findings from 1994-1997 experimental stocking of razorback sucker studies.

Methods:

Objectives 1-5: Three sampling trips will occur in 1998 to monitor stocked razorback sucker. The spring trip will sample from Hogback Diversion to Mexican Hat, Utah. Two other sampling trips will also take place. The time and sections of river to be sampled on these subsequent trips will depend on the results obtained during the spring sampling trip. Radiotelemetry of razorback sucker will take place on adult monitoring trips, trips to track stocked, adult Colorado squawfish, and additional trips throughout the year as is deemed necessary. Mechanical removal of nonnative fish species will take place on all razorback sucker monitoring trips.

Electro fishing, seining, trammel netting and radio telemetry will be used to determine what types of habitats stocked razorback sucker are using. Detailed habitat information on substrate, depth, cover, velocity, and relation of this habitat to other habitats (riffle, pools, main and secondary channels, backwaters, shore, etc.) will be recorded. Water quality parameters including dissolved oxygen, water temperature, conductivity, and pH will be measured at each location. PIT tag, growth, reproductive status, and general health information will be collected as well. General movement patterns will be determined through radio telemetry.

If a wild adult razorback sucker is captured, it will be PIT-tagged and held in a live cage until transport can be arranged to a hatchery facility. Once in captivity, wild adults will be used in paired matings that follow the San Juan River Genetics Management Guidelines to produce appropriate broodstock for the San Juan River. Handling and transport of wild adults will follow existing U. S. Fish and Wildlife Service protocols.

Data integration is underway and is scheduled to culminate in the production of a flow recommendation report in December 1997. A final report for the 1994-1997 experimental stocking of razorback sucker studies will be produced by summer 1998.

The Service will have the lead for the razorback sucker experimental stocking and monitoring and other cooperating agencies will provide personnel and equipment as needed.

Budget FY-98:

Personnel Costs:	
1 GM-13 Supervisor	$ 3,000
1 GS-11 Fishery Biologist	$ 11,000
1 GS- 7 Administrative Support	$ 1,000
Data integration and final report costs	$ 5,000
Travel-Per Diem	$ 3,000
Equipment and Supplies	$ 4,000
Subtotal	$ 27,000
Service Administrative Overhead (19.00%)	$ 5,100
TOTAL	$ 32,100

RADIOTELEMETRY OF STOCKED COLORADO SQUAWFISH ADULTS FISCAL YEAR 1998 PROJECT PROPOSAL

Principal Investigators: Dale Ryden and Frank Pfeifer
U. S. Fish and Wildlife Service, Grand Junction, CO
Contact at (970) 245-9319

Background:

Between June 1991 and October 1994, 13 wild, adult Colorado squawfish were implanted with radio transmitters between river miles (RM) 142 and 119.2 on the San Juan River. The data that was obtained during these studies helped identify staging and spawning areas, as well as helping determine habitat preferences for this species in the San Juan River. One objective of that study was to determine the effect of instream diversion structures on Colorado squawfish. However, with the exception of one contact with one Colorado squawfish, this objective could not be addressed in the earlier study due to the lack of upstream movement by Colorado squawfish adults. Information gained by observing what was believed to be spawning aggregations of Colorado squawfish and the types of habitats they were using was related by Bliesner and Lamarra to available habitat in other sections of the San Juan River. They found that the "upper" section of the San Juan River, adjacent to and upstream of Farmington, New Mexico, contained a large amount of what is believed to be suitable spawning habitat. In an effort to determine whether or not adult Colorado squawfish can retain and survive in this heavily partitioned reach of the San Juan River, 49 adult Colorado squawfish were stocked just below the confluence of the Animas and San Juan Rivers (RM 178.8) on 23 September 1997. These fish, 1981 year class progeny of paired matings between Yampa and Green River adults, are siblings of the adults used at Dexter NFH to produce the young Colorado squawfish that were stocked into the San Juan River in 1996 and 1997 by the Utah Division of Wildlife Resources (UDWR). Fifteen of these fish were implanted with one-year ATS radio transmitters to allow for monitoring of their habitat use and movements between diversion structures. All Colorado squawfish stocked were PIT-tagged before release into the wild. Stocking and monitoring of PIT-tagged and radio telemetered Colorado squawfish adults will help to address objectives 5.2.5, 5.2.9, and 5.3.8 in the San Juan River Long Range Plan. In addition, this stocking, as well as the stocking of young-of-the-year Colorado squawfish by the UDWR are precursors to a full-scale augmentation effort for Colorado squawfish in the San Juan River. A Five-Year Augmentation Plan for Colorado Squawfish in the San Juan River is currently being developed by this same office.

Follow-up monitoring has already begun. Radiotelemetry and electro fishing efforts during the week ending 3 October 1997 contacted 13 of 15 radio-tagged fish as well as recapturing 11 individuals (4 of which were radio-tagged fish). All but 1 of these 24 contacts occurred within 5 miles downstream of the stocking site. The last contact, an electro fishing recapture at RM 156.1, was below four major and two minor diversion structures. Additional monitoring of these

fish will take place on adult rare fish monitoring trips and at least eight radiotelemetry trips throughout 1997, and will be coordinated with work being done by Miller and Associates. Tracking will cover winter baseflow, spring pre-runoff, runoff, post-runoff (spawning), and summer/fall baseflow periods. Tracking of radio telemetered razorback sucker will also take place on these trips.

Objectives:

1.) Determine habitat use and needs, site preference, and movement patterns of hatchery-reared Colorado squawfish in the wild.

2.) Determine survival rates and growth rates of hatchery-reared, known-age Colorado squawfish in the wild.

3.) Determine whether hatchery-reared Colorado squawfish will retain and spawn in the reach of river adjacent to and upstream of Farmington, New Mexico.

4.) Determine the effects of the various instream diversion structures on adult Colorado squawfish movement patterns and habitat use.

Methods:

Objectives 1-4: Radiotelemetry, electro fishing, and trammel netting will be used to determine what types of habitats stocked Colorado squawfish are using. Detailed habitat information on substrate, depth, cover, velocity, and relation of this habitat to other habitats (riffle, pools, main and secondary channels, backwaters, shore, etc.) will be recorded. The location of utilized habitats to the nearest diversion structures will be examined to help determine the effect of these structures in partitioning groups of Colorado squawfish and the fishes ability to negotiate barriers and find other Colorado squawfish, especially during spawning periods. Water quality parameters including dissolved oxygen, water temperature, conductivity, and pH will be measured at each location. PIT tag, growth, reproductive status, and general health information will be collected as well.

If a wild Colorado squawfish is captured, it will be PIT-tagged, weighed, measured, and implanted with a radio transmitter. Surgical procedures will follow existing U. S. Fish and Wildlife Service protocols.

The Service will have the lead for the radiotelemetry of stocked Colorado squawfish adults and other cooperating agencies will provide personnel and equipment as needed.

Budget FY-98:

Personnel Costs:	
1 GM-13 Supervisor	$ 3,000
1 GS-11 Fishery Biologist	$ 11,000
1 GS- 7 Administrative Support	$ 1,000
Travel-Per Diem	$ 5,000
Equipment and Supplies	$ 4,000
Subtotal	$ 24,000
Service Administrative Overhead (19.00%)	$ 4,600
TOTAL	$ 28,600

SAN JUAN RIVER
RECOVERY IMPLEMENTATION PROGRAM
FY-1998 SCOPE-OF-WORK
RESEARCH PROPOSAL

Lead Agency:	Utah Wildlife Resources
Project Manager:	Leo Lentsch
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Phone:	(801) 538-4756
Field Coordinator:	Tom Chart Moab Field Station 1165 South HWY 191 - Suite 4 Moab, UT 84532 (801) 259-3781

Date: November 18, 1997
Date: November 18, 1997
Revised: January 29, 1998

Title of Proposal: Early Life Stage: Nursery Habitat Requirements for Colorado squawfish

Relationship to Long Range Plan:

3.1.2.1.b. Reproduction and recruitment, if any, will be documented. Areas of reproductive activity and nursery habitats will be identified and characterized. This information will be used to evaluate responses to different volumes of water released (including timing and duration) from Navajo Dam and to identify areas of essential habitat.
3.3.2.1.a. Characterize existing geomorphic and habitat conditions of the river preparatory for detailed habitat quantification and characterization.
3.3.2.1.b. Identify reaches of the river with similar geomorphic and habitat conditions.
3.3.2.1.c. Determine usage of specific habitats by endangered fishes as well as other native and non-native species.
3.3.2.1.d. Quantify habitat availability and characteristics at different flows to assist in the determination of the biological response of endangered fish species to test flows in the San Juan River. Evaluate the biological response of other species.
3.3.2.1.i. Monitor fate and usage by all species of habitats maintained or created by flow regimes, or other means. Evaluate need to continue management practices initiated as a result of this research.

3.3.3.1. Habitat availability, use and preference will be examined to determine if flows are adversely affecting habitat conditions.
3.3.3.2. Any recruitment and survival to the adult population will be coordinated with augmentation efforts already underway.
3.5.2.1.a. Characterize the distribution and abundance of each non-native species.

Background: This component of research has been designed to characterize the early life stage habitat requirements of the ichthyofaunal community in the San Juan River system. It is directed at specifically determining the seasonal use of low-velocity habitats (nursery) by age-0 and age-1 native and nonnative species. Platania (1990) estimated that Colorado squawfish spawned in the San Juan River during the months of July and August. Intensive sampling of low-velocity habitats is initiated in mid-August. Fall (September) sampling characterizes the fish community in low-velocity habitats and represents the faunal conditions as the community prepares to over-winter. Those fish that over-winter are sampled during the March period. Although these protocol have been written to answer specific questions on the San Juan River, much of the standardized sampling procedures draw heavily from existing protocols used currently on other Upper Basin rivers. The design is not intended to mimic those efforts, but rather to provide a method for comparison of data collected in the different systems.

Objectives for FY98:

1) To empirically monitor the annual recruitment of age-0 Colorado squawfish in relation to flow patterns in the San Juan River.

2) To determine the quality and quantity of low-velocity habitats in the San Juan River for use by Colorado squawfish through experimental stocking of age-0 fish.

3) To determine the effects of diversion canals on age-0 Colorado squawfish drift/movement (e.g., stranding, etc.).

4) To characterize the early-life stage icthyofaunal community in low-velocity (nursery) habitats.

5) To characterize nursery habitats and their use in the San Juan River system.

6) To determine overwinter survival and growth of experimentally stocked age-0 Colorado squawfish.

7) To determine habitats availability and use for age-0 and juvenile Colorado squawfish.

Methods:

Fish Community/Young-of-the-Year Monitoring: One Fall (September) sampling trip will be conducted to characterize the fish community in low-velocity habitats river wide. This trip will start at the Hogback diversion in New Mexico (RM 158.6) and terminate at RM 0. Two backwaters in each 5 mi reach will be sampled. Protocols will be consistent with 1992, 1993, 1994, 1995, 1996, and 1997 methods.

The contents of all seine hauls will be searched for target species. Target species will be measured to the nearest millimeter total length (TL) and released. A certain number of stocked fish will be preserved for other uses. All other specimens will either be: 1) identified and enumerated as adults or sub-adults, or 2) preserved in a 10% buffered formalin solution in Whirlpak containers. A sample label will accompany the specimens, and the sample number, date, and San Juan River Mile will be inscribed with permanent marker on the outer bag.

General habitat information will include: 1) date, 2) location, 3) primary habitat type, 4) specific habitat type, 5) river orientation, 6) main channel temperature, 7) habitat temperature, 8) total length, 9) width (at three locations), 10) depth (at nine locations), 11) landmarks, 12) and a sketch of the site. Fish collection information will include: 1) sample number, 2) seine used, 3) time, 4) orientation of haul, 5) length, 6) width, 7) maximum depth, 8) substrate type, 9) fish preserved, and 10) number of whirlpaks.

Continued evaluation of Nursery Habitat through experimental stocking of Age-0 Colorado squawfish: To enhance the ability to evaluate nursery habitat we will experimentally introduce age-0 Colorado squawfish. In 1998, 100,000 age-0 Colorado squawfish obtained from Dexter National Fish Hatchery will be marked with two unique tetracycline hydrochloride (TC) stains (different stain for each of two stocking sites) and stocked into the San Juan River. Colorado squawfish will be stocked at a mean size of approximately 25 mm (ranging 20 to 40 mm). Approximately 50,000 of each species will be stocked at two sites, Shiprock, New Mexico and Mexican Hat, Utah (an alternative to the Mexin Hat stocking site may be considered to better evaluate potential nursery habitat in more upstream reaches). During the first two years of experimental stocking of age-0 Colorado squawfish, fish were considered larger than those that would naturally occur at time of stocking. All attempts will be made in advance to acquire Colorado squawfish that will be the size that they would naturally occur at the time of stocking.

The primary objective of experimental stocking is to determine if the quality and quantity of low-velocity habitats in the San Juan River are sufficient to support retention and recruitment of age-0 Colorado squawfish. All low-velocity habitats (i.e., backwaters, eddies, and shorelines) throughout the geomorphic reaches will be sampled one week following the release of age-0 fish. This initial sampling will 1) determine if low-velocity habitats within each reach are retaining fish and 2) be in conjunction with current Colorado squawfish nursery habitat sampling (described above). After the first sampling, each reach will be sampled biweekly until deemed necessary.

Another objective is to determine the effects of diversion canals on age-0 Colorado squawfish distribution and survival (e.g., stranding, etc.). By stocking fish above the upper most nursery habitat reach (Below Hogback), we will be able to determine the affect of Cudei diversion (RM 142) on age-0 fish movement, distribution and survival (e.g., stranding). Field work for this objective will take place immediately following the stocking of age-0 fish during the first two weeks and continuation will be contingent on results of this sampling. Methods for this objective include the placement of drift nets and or hoop nets at the entrance of the diversion and in the main channel near the entrance. This will allow us to determine the relative number of stocked fish entering the diversion. Drift nets and/or hoop nets placed in the river channel parallel to the diversion will allow us to determine ambient densities of stocked fish in the main channel.

Studies Related to this SOW:

Two components of additional research may be completed at Utah State University if time permits. This research includes 1) lipid work on stocked Colorado squawfish and 2) determining stomach contents of stocked Colorado squawfish. To date stocked Colorado squawfish have been collected from nursery habitat reaches during the two trips completed to evaluate stocking. The same fish can be used for both research questions. Invertebrate work that has been completed as part of the UDWR nursery habitat study has demonstrated that productivity tends to be higher in the upper nursery habitat reaches than the ones down lower in the system. This is especially true for the Grand Gulch reach; this reach is the lowest in productivity, however this is the reach were most wild age-0 Colorado squawfish have been captured. This work will determine if stocked Colorado squawfish incur more lipids higher in the San Juan system and if so, will this benefit these fish through overwinter survival.

Future Studies:

In the future UDWR would like to expand the experimental stocking program to evaluate survival, dispersal, and nursery habitat use of Age 0 razorback suckers. Optimally, study animals would be the progeny of previously stocked razorbacks (see USFWS scope of work), however hatchery raised razorback sucker YOY could act as a surrogate if needed.

Integration:

We will be integrating all research UDWR has completed on the San Juan River. We will be incorporating pertinent results from our Upper Basin projects into the integration as well. The information gained from this project will be pertinent for all Upper Basin research including the San Juan. Travel will entail attending all subcommittee meetings.

BUDGET- FY98*:

Personnel	$ 92,000
Travel	$ 7,000
Equipment	$ 20,000
Integration	$ 10,000
TOTAL	$ 129,000

* Included in the budget is a subcontract with USU for study and travel. Travel budget with USU includes out-of-state expenses for UDWR personnel.

SAN JUAN RIVER LARVAL FISH PASSIVE DRIFT-NETTING WORK PLAN AND BUDGET FY 1998

Submitted by

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Background:

Beginning in spring 1995, personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico assumed responsibility for the San Juan River larval fish passive drift-netting study. This project, formerly conducted by the Utah Division of Wildlife Resources, continued with only minor changes in sampling protocol. Data collected from this research activity provided several discrete types of information on the fishes of the San Juan River. Data that can be obtained on the endangered fishes of the river include determining approximate spawning period, identifying approximate location of spawning sites, and assessing affects of annual hydrology (and temperature) on their reproductive activities. Similar data are also obtained for other members of the ichthyofaunal community and contrasted with previously drift-net sampling to assess the affects of that year's flow regime on fish reproduction. Samples collected during this research program were and will continue to be processed and curated by Fish Division personnel at the University of New Mexico.

Since assuming responsibility for this phase of the research program, we have collected three larval Colorado squawfish. Two larval Colorado squawfish were taken at Mexican Hat during the 1995 larval fish passive drift-netting study. The first specimen, 9.5 mm TL mesolarvae (MSB 26187) was taken between 2114-2310 hours on 2 August 1995. The next morning (3 August

1995) between 0531-0800 hours, a second Colorado squawfish, 9.0 mm TL mesolarvae (MSB 26191) was collected. The first larval Colorado squawfish from the Mixer site was collected on 2 August 1996 (MSB 29717). These specimens were collected during years with extremely different flow regimes. The 1997 drift netting samples have not finished being processed.

A comparison of 1995 morning versus evening drift-net sampling indicated no significant differences. However, the supplemental data produced by evening sampling provided additional resolution to questions concerning drift patterns. Given the relative rarity of target species in the San Juan River and the extremely limited number of larval Colorado squawfish and roundtail chub collected, we redesigned passive drift-netting protocol for 1997 so that sampling can be conducted during both morning and evening. In addition, we instituted a sampling regime to be conducted during the first week of August that called for nets to be set every other hour. Unfortunately, we experienced extremely high flow during this portion of the summer which resulted in the collection of massive amounts of debris in relatively short time periods. We had to discontinue this sampling protocol after only a few days.

The lack of adult Colorado squawfish with functioning radio tags has precluded our attempts to sample the drift below the putative spawning bar during the presumed period of spawning by this species. We propose an intensive sampling effort during a 2-3 week period from the end of July to the middle of August. We will employ a new fish collecting device that we developed for collection of eggs and larvae on the Pecos River, New Mexico. We envision sampling immediately downstream of the putative spawning bar for about eight hours per day (depending on flow). One advantage this device has over the drift nets for the collection of larvae is that, under moderate flow, drift is immediately sorted (while in the river) so there is no laboratory time is necessary for picking of samples (which is the most time consuming portion of drift net sampling). During very large flow events, such as those experienced during summer 1997, this unit would be no more effective or efficient than drift nets. Illustrations and a brief description of the function and details of this unit follows.

The Moore Egg collector (MEC) is a sluice-box-like collection device with a rectangular opening at its anterior end, parallel wooden sides and an open top (Figure 1). The bottom is a framed nylon window screen installed at an angle relative to the bottom mounting bar. Mounting bars are attached near the posterior end of the mouth and perpendicular to the sides. The MEC operates just below the water's surface to prevent the collection of floating debris. A wedge-shaped water diverter is positioned on the top of the front flume to reduce drag when the MEC is set in high flow habitats.

The MEC was primarily constructed of 3/8" C:D grade plywood, 1" x 2" pine furring strips, and zinc-plated wood-screws. To extend the life of the collecting device, all wood surfaces received at least two coats of high quality marine varnish. Screening was held in place by wood staples and silicone caulk and can easily be repaired or replaced with a different mesh size to suit individual study objectives. The diverter is constructed of aluminum plate.

During operation, the MEC is held in place by the force of the water pushing the mounting bars against two t-posts driven into the stream bottom (Figure 2). Two electric fence insulating brackets are attached to each t-post to provide an adjustable platform for the mounting bars. Drift that enters the MEC becomes entrained on the screen while the current carries the spherical, semi-buoyant fish eggs up the inclined screen. Larval fish can be easily gathered, counted and collected with an eyedropper before being placed the water-filled (and removable) collection cup.

Debris that enters the MEC accumulates and can eventually clog the screen and impede the flow of water through the mouth. The operator can gather and discard the large particulate debris captured by the MEC by gently rubbing their hand across the submerged portion of the screen. Fine particulate matter that collects on the screen can easily and quickly be cleared by immersing the posterior portion of the MEC into the water which reverses the flow of water through the screen and removes the remaining debris. The interim between screen clearings is dependent on the amount of debris in suspension and velocity of water being sampled but generally ranged between two minutes and several hours.

Capture rate of drift can be calculated by determining the volume of water filtered during the sampling period. A flow metering device can be mounted in the mouth of the MEC. Sampling effort can be calculated using the area of the mouth and appropriate formula for the flow meter being employed.

Objectives;

1.) Determine the temporal distribution of San Juan River ichthyoplankton in relation to the hydrograph

2.) Provide comparative analysis of the reproductive success of San Juan River fishes

3.) Attempt to characterize downstream movement of ichthyoplankton

4.) Attempt to validate presumed spawning period of Colorado River squawfish

5.) Institute a short-term but intensive sampling regime in the proximity of the presumed Colorado squawfish spawning bed using the MEC as the principal collecting device.

Methods:

1.) Collect daily drift samples at two predetermine localities (Four Corners and Mexican Hat) starting in June and continuing until the end of August. Nets will be set each day at dawn and dusk and left in the water for about two-hours. The amount of water filtered by each net (m^3) will be measured by General Oceanic Flow-meters (Model 2030R) suspended in the center of the nets. This information

(m^3) will allow us to determine catch per unit effort based on volume of water sampled versus time sampling.

2.) At the end of each two-hour net-set period, the contents of each net will be rinsed into separate one-gallon plastic bags, labeled with unique field numbers, and preserved in 10% formalin. Drift material will be allowed to cure for at least two days before samples are processed and fishes separated from the debris. Cleaned samples were returned to the laboratory for analysis. All fish specimens will be identified and counted. In addition, specimens will be assigned to more coarse categories such as "drift" and "incidental". The former category refers to individuals with minimal or no control over their longitudinal movement. The latter classification refers to individuals whose developmental stage should have allowed them to avoid capture in passive drift nets.

3.) Data will be converted to catch rate and compared across and within sites by species. In addition, catch rate between and within sites will be compared across time (1996 samples). Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph.

4.) Coordinate with San Juan River researchers who are tracking the movements of Colorado squawfish and identify the putative spawning area for that species. Establish study sites in close proximity of Colorado squawfish spawning area. Conduct daily larval fish sampling using MEC and other appropriate collecting devices for a 2-3 week period when larval Colorado squawfish are thought to be leaving the nests and beginning the drift portion of their life history.

Budget:

DRIFT-NETTING

Personnel	$ 20,000
Travel and Per Diem	$ 3,000
Equipment and Supplies	$ 1,500
Subtotal	$ 24,500
Overhead (15%)	$ 3,675
TOTAL	**$ 28,175**

MONITORING SAN JUAN RIVER SECONDARY CHANNEL FISH COMMUNITIES

Principal Investigators: David L. Propst and Amber L. Hobbes
Conservation Services Division
New Mexico Department of Game And Fish

Background:

Spring, summer, and autumn monitoring of San Juan River fish communities since 1992 has documented differences in the fish communities of primary and secondary channels. Differences were noted in species and life-stages of each present, their relative abundance, and the habitat used by each (species and life stage). Differences were hypothesized to be mediated in part by differences in habitats available at various river flows. In addition, some differences were enhanced because of different sampling methodologies. For example, during autumn monitoring inventories, boat-mounted electro fishing gear was used to obtain fish in the primary channel whereas drag seines were used in secondary channels. In addition to detecting differences in the communities of secondary and primary channels, secondary channel studies documented species-specific longitudinal abundance patterns within seasons and distinct seasonal changes in the composition of secondary channel fish communities. These findings prompted intensive studies (1993 through 1996) on four secondary channels that, among them, were representative of the array of San Juan River secondary channels. These studies found that high spring flows serve to annually "reset" the fish community of secondary channels (Gido et al., 1997) and that during low flow periods there is considerable overlap in habitat use by resident species (Gido and Propst, in press). During spring runoff, the fish assemblage of secondary channels is numerically dominated by native fish species, but as runoff recedes nonnative fishes become progressively more abundant and by late summer and early autumn numerically dominate, by a large margin, secondary channel fish communities. Different reproductive strategies were also hypothesized to contribute to the shift in community composition. Common native fishes (*Rhinichthys osculus, Catostomus latipinnis,* and *Catostomus discobolus*) spawn prior to and during spring runoff and common nonnative fishes (*Cyprinella luturensis* and *Pimephales promelas*) spawn after recession of spring flows. As flows recede and habitat availability changes, the abundance of common native fish species in secondary channels decreases. Associated with changes in relative availability of habitats are changes in quality; for example, water temperature increases and dissolved oxygen decreases.

Seining of primary channel shoreline habitats during summer and autumn secondary channel monitoring trips was initiated in 1996 to provide additional information on the primary channel fish community. This sampling was done at each sampled secondary channel or at three-mile intervals, whichever was most frequent.

After cessation of spring runoff, secondary channel habitats are largely slow velocity runs and shallow pools. Low-velocity areas are believed to provide important nursery habitats for Age 0 Colorado squawfish. Prior to autumn 1996, no Age 0 Colorado squawfish was found in San Juan River secondary channels, but following the November 1996 and September 1997 stocking of Age 0 Colorado squawfish in the San Juan River, individuals were found in secondary channel habitats. For example, during 1997 autumn secondary channel monitoring 240 Age 0 Colorado squawfish were found in 20 secondary channels between RM 155 and 87. In addition to the Age 0 individuals, 2 Age 1 Colorado squawfish were found in secondary channels during the same sampling trip. In contrast, only 36 Colorado squawfish were found in primary channel seine collections (those accomplished in conjunction with secondary channel monitoring). This information indicates that secondary channel habitats are utilized, perhaps preferentially, by Age 0 Colorado squawfish.

Methods:

During fiscal 1998, secondary channel monitoring will accomplished with summer and autumn inventories conducted from Hogback to Mexican Hat. The autumn effort will be accomplished in conjunction with the primary channel adult monitoring efforts (under direction of USFWS-Grand Junction). Spring monitoring of secondary channels has been discontinued. Sampling protocol will be the same as in previous years. Sampling of primary channel shoreline habitats will continue as in 1996 and 1997 except that the maximum distance between primary channel samples will be three miles instead of one mile (time and resource constraints require less frequent sampling than proposed in 1997). Data obtained from primary channel shoreline samples will be compared to that from secondary channels to characterize the relative similarity of the "small" cyprinid assemblages of each. During summer and autumn efforts, secondary channels are sampled by mesohabitat (e.g., pool, run, and riffle). Surface area, water velocity, depth, substrata, and cover of habitats from which Colorado squawfish are collected will be measured.

Study Objectives:

Characterize the fish fauna of secondary channels: A report documenting the fish fauna of San Juan River secondary channels is being prepared as part of the integration report. This objective will be completed during fiscal 1998. The report will characterize seasonal and longitudinal changes in secondary channel fish communities and relate changes in the fish community to changes in abiotic conditions (e.g., thermal and flow regimes and channel dimensions).

Characterize physical attributes of secondary channels: The report characterizing the fish fauna of secondary channels will also include characterization of their physical attributes.

Work on the above objectives was initiated during fiscal 1997 and will be completed during fiscal 1998 as part of the Integration report. Continued monitoring of secondary channel fish communities will contribute to achieving the following objectives.

1.) Evaluate the use of secondary channels by stocked Colorado squawfish and razorback sucker.

2.) Characterize the secondary channel habitats used by Colorado squawfish and razorback sucker.

3.) Compare secondary channel habitats used by Colorado squawfish and razorback sucker to those each species uses in the primary channel.

4.) Identify potential management actions to enhance suitability of secondary channels for native species, particularly Colorado squawfish and razorback sucker.

5.) Document changes in the fish fauna of secondary channels in response to different flow regimes.

6.) Characterize the fish community of primary channel shoreline habitats (longitudinally and by geomorphic reach) and compare to that of secondary channels (this study was treated separately in the fiscal 1997 work plan).

7.) Identify potential management actions that might enhance secondary channel habitats for native fishes.

Data obtained from other research activities will be used in achieving Objectives 1 through 5. Appropriate univariate and multivariate statistical procedures will be used in data analyzes.

Development and implementation of a long-term standardized monitoring program of fish assemblages is identified in the Long Range Plan as essential to practicing adaptive management in the San Juan River system (Objective 5.7.1). Because secondary channels provide habitats that are uncommon in the primary channel and seasonally support large numbers of several nonnative species that have been identified as potential competitors/predators of native species (particularly protected native fishes), monitoring the response of secondary channel fish assemblages to implemented management strategies is essential to evaluating their effectiveness. In addition, regular monitoring of secondary channels provides information that aids in achievement of Long Range Plan Objective 5.4, particularly 5.4.1 and 5.4.4.

Integration:

Completion of data analyzes, preparation of research reports, and integration of these are ongoing and will continue to require a major commitment of resources. Among the objectives of the integration effort is the development of flow recommendations. Accomplishment of this objective will require attendance at various subcommittee and committee meetings, acquisition of data from other research activities, integration of these data into documents supporting particular flow recommendations, and synthesis of reports and documents.

Literature Cited:

Gido, K.B., D.L. Propst, and M.C. Molles, Jr. 1997. Spatial and temporal variation of fish communities in secondary channels of the San Juan River, New Mexico and Utah. Environmental Biology of Fishes 49: 417-434.

Gido, K.B. and D.L. Propst. In press. Habitat use and associations of native and nonnative fish in the San Juan River, New Mexico and Utah. Copeia 1998:00-00.

Fiscal 1998 Budget[1]:

Secondary Channel Community Monitoring	
Personnel	$ 6,000
Travel and Per Diem	$ 4,000
Data Compilation and Analysis	
Personnel	$ 10,000
Research Integration	
Personnel2	$ 20,000
Travel and Per Diem	$ 6,000
Administrative Support	$ 2,000
Total	$ 48,000
Indirect Costs	$ 4,800
TOTAL	**$ 52,800**

[1]Budget does not include in-kind contributions

NON-NATIVE SPECIES MONITORING AND CONTROL
FISCAL YEAR 1998 WORKPLAN PROPOSAL

Principal Investigators - Jim Brooks and Mike Buntjer
New Mexico Fishery Resources Office, U.S.F.W.S., Albuquerque, NM

Background:

Introduced species have been implicated in the decline of several native fishes. In the Colorado River drainage, introductions occurred simultaneously with flow-related habitat alterations. These events coincided with a basin wide decline in distribution and abundance of many native species, in particular the Colorado squawfish and razorback sucker. Various laboratory and field studies have described the interactions among native and non-native species. Impacts on native fishes include resource overlap in both diet and habitat use (i.e., potential competition), predation, and hybridization.

During 1991-1997, this component of the San Juan River research has focused on the identification of the impacts of non-native species on the native fish community. Research has characterized the distribution and abundance of non-native species in main channel habitats, seasonal movements of channel catfish and common carp, the food habits of non-native predators, primarily channel catfish, the overlap of resource use between native and non-native fish species, and the relation of these findings to differing flow regimes. Channel catfish are the single most abundant large non-native predator in main channel collections. Data indicate that channel catfish occupy a variety of habitats within the main channel, generally exhibit localized movement, and at lengths > 450mm prey upon native species.

Mechanical removal during 1996 main channel electro fishing efforts removed a variety of non-native species including 6,319 channel catfish, 5,084 common carp, 32 walleye, 20 largemouth bass, 18 striped bass, 14 green sunfish, and 11 black bullhead. With the implementation of more natural flows in the San Juan River during future recovery efforts, primarily high spring flows, that attempt to minimize non-native species numbers, continued mechanical removal may prove beneficial. However, mechanical removal of a sport fish species is not widely accepted by the public unless those fish removed are made available to the public elsewhere.

This workplan proposes to continue mechanical removal of channel catfish and other non-native species in conjunction with main channel adult monitoring and rare fish stocking efforts. Monitoring data on the distribution and abundance of non-native species will continue to be collected and analyzed. In addition, a management program to capture and transplant San Juan River channel catfish to isolated impoundments currently used for recreational fisheries will be developed. This will require coordination with Tribal, State, and local interests and will have to

address health issues regarding both fish health and human consumption. Preliminary contacts indicate that removal and relocation of channel catfish could begin during 1998 on a limited basis. Support will also be provided for completion of study integration efforts and issue of flow recommendations.

Objectives:

1.) Continue data collection and mechanical removal of non-native species during main channel adult rare fish monitoring efforts.

2.) Evaluate data for non-native species to determine effects of mechanical removal on abundance and distribution patterns.

3.) Develop interjurisdictional support for mechanical removal and transplantation of channel catfish.

4.) Design and implement a management program to capture, hold and transport channel catfish to recreational waters isolated from the San Juan River.

5.) Continue data integration efforts for production of flow recommendations from Navajo Dam.

Methods:

Mechanical removal will occur during the five adult sampling trips proposed by Ryden and Pfeifer: April, June and July sampling from Farmington to Hogback, August sampling from Mexican Hat to Clay Hills, and October sampling from Hogback to Mexican Hat. Primary sampling method will be by raft-mounted electro fishing. Hoop and trammel netting efforts will be employed on a selective basis in association with main channel sampling efforts.

All non-native species collected will be identified, enumerated, measured for total and standard lengths, and weighed and data recorded for inclusion into the standardized database. In addition, lacustrine non-native species (striped bass, walleye, largemouth bass) collected in the San Juan River will undergo field examination for stomach contents to identify predation on rare and other native fish species. Tagging data for recaptured channel catfish and common carp will be integrated into existing data bases for movement and abundance.

Coordination efforts will be initiated in December 1997 for mechanical removal and transplantation of channel catfish. This will include contact with the Navajo Nation, states of New Mexico and Utah, and local anglers to identify issues and concerns. Fish health and contaminants data will be incorporated into an overall strategy for the removal and transplanting of channel catfish. A management plan will be formulated that specifies agency responsibilities, methods of capture,

SAN JUAN RIVER RECOVERY IMPLEMENTATION PROGRAM
SEVEN YEAR RESEARCH PROGRAM
DRAFT BUDGET
FISCAL YEAR 1998

I. Continued Research and Management Projects

Adult Rare Fish Monitoring (USFWS,R6)	$ 50,000
Evaluation of Stocked Razorback Sucker (USFWS,R6)	32,100
Radiotelemetry of Stocked Colorado Squawfish Adults (USFWS,R6)	28,600
Early Life Stage: Nursery Habitat Requirements (UDWR)	129,000
Larval Fish Passive Drift Netting (UNM)	28,175
Secondary Channel Fish Community Monitoring (NMDGF)	52,800
Nonnative Species Monitoring and Control (USFWS,R2)	65,500
Videography (USBOR)	8,000
Aerial Photography (USBIA)	15,000
Specimen Curation and Larval Fish Identification (UNM)	35,650
Biological Effects of Contaminants (USGS)	12,000
Fish Health Studies (USFWS,R2)	6,000
Synthesis Report Preparation (BioWest)	30,000
Peer Review (BioWest)	15,000
Program Management (USBOR)	30,000
Program Coordination (USFWS)	47,100
Subtotal	**$584,925**

II. New Research and Management Projects

Larval Razorback Sucker Collection From Lake Mohave (USFWS,R6)	$ 11,900
Rate Determination of Downstream Transport of Drift (UNM,NMDGF)	11,915
Larval Razorback Sucker Survey (UNM,NMDGF)	16,100
Flow Effects on Spawning Success of Red Shiner (NMDGF,UNM)	26,400
Tech./Editorial Support for Flow Recommendation Report (BioWest)	20,000
Summer Habitat Use by Colorado Squawfish (Miller Eco.)	21,765
Winter Habitat Use by Colorado Squawfish (Miller Eco.)[1]	*58,610*
PIT Tag Acquisition (SJRRIP)	24,000
Subtotal	**$ 132,080**
Total	**$ 717,005**

[1] Not Presently funded or included in total.

SAN JUAN RIVER BIOLOGICAL EFFECTS STUDIES
FISCAL YEAR 1998 PROJECT PROPOSAL

Principal Investigator: Steve Hamilton, U.S. Geological Survey

Background:

Limited analyzes of water, sediment, and tissue collected from the San Juan River have shown the presence of selenium and other inorganics and organics at concentrations that could potentially be harmful to fish and wildlife. However, the biological significance of short-term (acute) or long-term (chronic) exposure to these elevated inorganics and organics to threatened or endangered fish in the San Juan River is unknown. Information is needed to identify waterborne and dietary contaminants that may adversely affect the recovery of threatened or endangered fish. Acute tests should be conducted with individual inorganics and organics and with mixtures of inorganics and organics in their environmental ratios found at potentially harmful sites along the San Juan River used as nursery areas by endangered or threatened larval fish or staging areas by adults. Those inorganics and organics that show high toxicity in acute toxicity tests relative to their environmental concentrations should be further evaluated in long-term tests to determine sublethal effects and to delineate the relation between whole-body burdens and other biological effects. Long-term tests are needed with endangered adult fish to assess the potential for inorganic and organic contaminants to adversely affect reproduction.

Objectives:

Determine the chronic effects on reproduction of adult Colorado squawfish (Ptychocheilus lucius) of combined waterborne exposure to a mixture of inorganics and a dietary exposure to organic selenium.

Methods:

In 1997, a long-term chronic toxicity test was conducted according to standard methods, except that the water quality simulated that in the San Juan River. The test species was adult Colorado squawfish acquired from Dexter National Fish Hatchery & Technology Center, NM. The test was conducted for 154 days with fish exposed to dietary (0, 5, & 10 μg/g) and waterborne (0 & 5 μg/liter) selenium (FISH WERE READY TO SPAWN ABOUT 30 DAYS EARLIER THAN EXPECTED, SO THE EXPOSURE WAS NOT 180 DAYS AS PLANNED). The study included three replicates each of a control and five treatments. After exposure to dietary and waterborne selenium, adults were induced to spawn and the resulting hatched larvae held for 30 days post-hatch. Tissue residues of selenium in adults were monitored before spawning and for 90 days (ORIGINALLY PLANNED FOR 60 DAYS) after spawning when adults were held in clean water and fed control diet to determine depuration rates.

The water temperature and photoperiod simulated conditions in the San Juan River. The water quality in chronic toxicity test simulated that in the San Juan River in terms of the major cations and anions at Shiprock, New Mexico: hardness 150 mg/L, alkalinity 89 mg/L, Ca 43 mg/L, Mg 9.2 mg/L, Na 22 mg/L, Cl 5.9 mg/L, SO_4 89 mg/L (Beal, L.V., and R.L. Gold. 1986. Water Resources Data New Mexico Water Year 1986. USGS Water Data Report NM-86-1, Albuquerque, NM. Station ID 09368000, 11/05/85, Shiprock, NM).

The biological measures in the test with adults included water residues of selenium (samples collected at 15-day intervals), dietary residues of selenium (samples collected from each bag of diet), tissue residues of selenium (muscle plug samples, includes depuration), survival (recorded daily), growth (length and weight measured), number of eggs spawned, and number of eggs hatched.

The biological measures for the 30-day larvae study included tissue residues of selenium (samples collected at day 0, 15, and 30), fish survival (recorded daily), and growth (length and weight measured at the end of the study).

Work in 1998 will involve writing the summary report of this research. The biological endpoints from the adult and larval studies will be compared to each other to derive inter-relations of various measures (i.e., tissue residue vs. effects on growth) and compared to environmental data from the synoptic survey conducted by others to derive a hazard assessment of the potential of the waterborne and dietary selenium to adversely affect threatened or endangered fish in the San Juan River.

Budget:

Long-term Reproduction Test with Adult Colorado Squawfish	
Personnel	$ 9,000
Travel/Per Diem	$ 1,084
Subtotal	$ 10,084
USGS Admin. Overhead - 19%	$ 1,916
Proposed Budget FY98	$ 12,000

SAN JUAN RIVER SPECIMEN CURATION AND LARVAL FISH IDENTIFICATION WORK PLAN AND BUDGET 1998

Submitted by

Steven P. Platania (Principal Investigator)
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Background:

Personnel from the Division of Fishes, Museum of Southwestern Biology (MSB), at the University of New Mexico are responsible for two inter-related programs on the San Juan River. The Fish Division is the repository for specimens collected and retained by researchers. Fish taken under these programs are initially sorted by the principal investigator, held until they have submitted their yearly-progress report, and then received by MSB personnel. The collection is accessioned, specimens transferred from formalin to alcohol, identifications verified, individuals enumerated, length ranges recorded (largest and smallest specimen in a collection), collection data verified and transferred to wet labels, and incorporated into a database. Changes in species identifications are noted and returned to the principal investigator along with the entire data set (listing of collection locality, collectors, date, original field number, species, number of specimens, length ranges, and museum catalog number). In addition to performing duties associated with collections curation, we are also responsible for complete processing (sorting, identifying, counting, curating, and reporting) of selected San Juan River collections (larval drift, some secondary canal and miscellaneous collections made by various San Juan River researchers [lower San Juan River collections; U.S.B.R.-Lashmett; National Park Service]).

In 1996 we processed almost 50,000 larval and juvenile fishes collected by the Utah Division of Wildlife Resources and University of New Mexico. Five fish, previously identified as roundtail chub were found in the collections from the Utah Division of Wildlife Resources. The specific identification of those specimens were verified by Darrel E. Snyder, Larval Fish Laboratory, Colorado State University. The 1996 Utah Division of Wildlife Resources low-velocity habitat samples were received in July 1997 and will process them by the beginning of summer 1998. As in the past, any significant deviations in the species identifications of those samples will be noted and forwarded to the principal investigators.

Objectives:

1.) Provide a permanent repository for San Juan River fish collections, field notes, and associated data

2.) Verify species identifications

3.) Assist principal investigators with collection sorting and identifications

4.) Sort, identify, enumerate, and report on larval fish drift collections

Methods:

1.) Samples from projects are received after the principal investigator has completed their work and prepared the necessary annual report. This means that there will be a lag of one year in reference collection of specimens and processing of those samples. All collections are matched with the appropriate data-sheet, transferred from formalin to alcohol, stored in museum quality jars, re-identified, counted, measured (range) labeled, and catalogued into the permanent fish division collection.

2.) We have assisted principal investigators by taking on the responsibility for processing unsorted collections. Specimens are sorted, identified, counted, measured, catalogued, and data submitted the principal investigator for inclusion in reports. In the past, this work has had to be done on relatively short notice.

3.) Larval drift collections are received unsorted and processed as stated above. In addition to recording the length ranges for each species in each collection, we also note the presence of larval, juvenile, and adult specimens in the samples. Starting in 1995, the annual report for the larval fish portion of the study will be prepared by UNM personnel.

Budget:

Personnel	$ 27,000
Travel and Per Diem	$ 1,000
Equipment and Supplies	$ 3,000
Subtotal	$ 31,000
Overhead (15%)	$ 4,650
TOTAL	$ 35,650

WORK PLAN / SAN JUAN RIVER FISH DISEASE MONITORING 1998
PINETOP FISH HEALTH CENTER

Principal Investigators
John Thoesen, J. Jerry Landye, and Beth McCasland, U.S.F.W.S.

Background:

Since October 1992, this laboratory (Pinetop Fish Health Center) has participated on adult monitoring and various smaller sampling trips on the San Juan River. We have collected fish health samples from many different fish species. The primary concern was the number of lesions observed in various species of fish and whether this problem would affect Colorado River squawfish and/or razorback suckers. These lesions appear to have a cyclic nature in their prevalence. During even calendar years a high number of lesions are found, while odd years the number observed are low.

We propose to collect and maintain a fish health data base on the spring razorback main channel monitoring trip in FY-98 and take nonlethal fish health samples from all razorback suckers and Colorado River squawfish encountered. Because 1998 should be a high lesion year and the number of squawfish and razorback suckers present is increasing, these samples are of particular importance. Channel catfish will be lethally sampled in order to provide a fish health inspection of the population prior to transfer to other waters. Additionally data collected by other San Juan River biologists from the fall adult monitoring will be analyzed for disease incidence.

Objectives:

1.) Continue monitoring the health status of San Juan River fish.

2.) Obtain fish health inspection samples from channel catfish from selected areas to facilitate transfer of catfish to other aquatic habitats.

3.) Monitor the fish health status of all Colorado River squawfish and razorback suckers encountered.

Methods:

1.) Every river mile (RM):
   a) record macro-pathology on all fish sampled.
   b) only selected fish with gross pathology will be sacrificed and sampled for pathogens. Non-lethal sample methods will be utilized whenever possible.

c) Colorado River squawfish and razorback suckers will be sampled utilizing only nonlethal sampling techniques.

d) Channel catfish will be sampled for fish health inspection samples.

2.) Every designated mile (DM):

a) record macro-pathology on all fish sampled (internal and external).

b) sacrifice five *Catostomus latipinnis* and obtain bacterial samples for epizootic fish pathogens.

c) assist other San Juan River biologists by analyzing data collected from electro fishing boats for disease incidence from the fall adult monitoring trip.

Budget:

Personnel (field and laboratory support)	$ 4,500
Per Diem/Travel	$ 2,000
Equipment (lab and field supplies)	$ 500
Total	$ 6,000

TECHNICAL AND EDITORIAL SERVICES TO COMPLETE THE SYNTHESIS REPORT FOR THE SAN JUAN RIVER

Paul B. Holden, Principal Investigator
BIO/WEST, Inc., Logan, Utah
Jicarilla-Apache Tribe
Fiscal Year 1998 Work Plan

Background:

Since 1991 the San Juan River Recovery Implementation Program (Program) has been involved in a seven-year research effort. Much of the research has been directed by the Long Range Plan, a document prepared by the Program to show its goals and objectives, and the plan for meeting those goals and objectives. As the seven-year research program draws to a close, final reports on the various research projects are due. But a need exists to integrate the findings of those reports and put them in a format understandable to non-biologists, and in a format that shows the accomplishments of the Program in relation to its goals and objectives.

The Biology Committee of the Program has proposed developing a Synthesis Report that will address the results of the seven-year research program as they relate to the goals and objectives of the Long Range Plan. Such a report will be a compilation of the results from numerous authors, and will require a single point of contact to turn the report into a single document that summarizes all the research that has been conducted. Paul Holden of BIO/WEST, the Jicarilla-Apache Tribe representative on the Biology Committee, was given the responsibility to provide overall coordination for the report.

This proposal provides for the funding for the technical, editorial, and production capabilities to complete the draft Synthesis Report by June 30, 1997, and a final version of the report by the end of September 1998.

Goal:

The goal of this proposal is to provide the technical and editorial services necessary to produce a document that accurately describes the research results for the seven-year research program and that clearly describes how those results met the goals of the Program .

Methods:

BIO/WEST has served as an editorial and technical focus point for the Program in the past by completing annual Integration (Summary) Reports, and in having overall responsibilities for the completion of the Flow Recommendation Report. During 1998, and annual Integration Report will not be prepared since a major effort will involve developing the Synthesis Report. The

BIO/WEST role in this project will be very similar to their past efforts for the Program. It is anticipated that as the various authors complete their portions of the synthesis report, or their final research reports, that those portions will be forwarded to BIO/WEST. Dr. Holden will review each section for technical completeness and call authors as needed for clarification. Dr. Holden will summarize or abstract the reports as required and put them into a format for the Synthesis Report that has been agreed to by the Biology Committee. He will then forward them to BIO/WEST's Senior Editor for editorial review. The Senior Editor will work with Dr. Holden to assure the various portions of the report are compatible, rewriting as necessary to make a document that is consistent and easy to read. Once the draft document is final, it will be printed and bound, and mailed to the Biology Committee for review. Following review by the Biology Committee, a final report will be completed incorporating pertinent comments. The final report will be sent to the Coordination Committee and other Program participants.

Personnel:

Dr. Paul Holden will provide technical review of the document preparation as well as primary authorship of summary sections. Mr. Bill Masslich, or Mr. Jack Ruppert, may assist Dr. Holden with various portions of the report. Ms. Krista McHugh, BIO/WEST's Senior Editor, will provide the overall editorial review of the document, including any rewriting of sections as needed. Ms. McHugh will use her staff of editors, clerical specialists, and cartographers as needed to assist with document completion.

Primary Contact:

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Budget:

Personnel	$ 26,000
Travel	$ 1,000
Printing and Misc.	$ 3,000
Total	$ 30,000

PEER REVIEW FOR 1998

Paul B. Holden, Principal Investigator
BIO/WEST Inc., Logan, UT
Jicarilla-Apache Tribe
Fiscal Year 1998 Work Plan

Background:

During 1997 a Peer Review Panel was established that included the following scientists:

Dr. Clark Hubbs - Fishery ecologist and professor emeritus from the University of Texas. Clark served on the Peer Review Panel for the Grand Canyon Environmental Studies.

Dr. Peggy Shute - Endangered Fish Biologist with TVA who is actively working on similar endangered species issues in the eastern U.S.

Dr. David Galat - Fishery Ecologist with the National Biological Survey and Missouri Cooperative Fishery Unit who is working on native fishes and instream flow issues on the Missouri River.

Dr. Ellen Wohl - Associate Professor in the Department of Earth Sciences at Colorado State University. Ellen has been involved with peer review of Upper Colorado River Basin projects and has expertise is geomorphology and sediment transport.

Dr. Ron Ryel - Biostatistician and ecologist with experience in population modeling. Ron has been involved with endangered fish issues in the Grand Canyon and the Upper Colorado River Basin.

In addition, Mr. Ned Andrews of the U.S. Geological Survey also agreed to serve as a peer reviewer but could not make scheduled meetings at the end of 1997. The Peer Review Panel will meet with Biology Committee on October 28, 1997 during a meeting in Farmington, NM to discuss the flow recommendation procedure. They will provide written comments on that meeting, and then will also review the draft flow recommendations report when it is completed in January 1998.

It is anticipated that additional integration and final reporting activities will occur in 1998 as a synthesis report is prepared to summarize the results of the seven-year research program, in addition to a final flow recommendation report. The Peer Review Panel will be used to interact with the Biology Committee, meeting with them at least twice during the calender year, and reviewing documents as they are produced.

This proposal provides for funding to maintain the Peer Review Panel activities during 1998.

Goal:

The goal of peer review is provide additional scientific oversight over San Juan River Recovery Implementation Program technical studies and reporting. The Peer Review Panel will work with the Biology Committee to produce scientific credible documents and will assist the Biology Committee in maintaining a highly scientific direction to the Program.

Methods:

The Peer Review Panel will meet with the Biology Committee on an as needed basis, but likely no more than two times during 1998. They will also review Program reports when they are in draft and final form, including the draft and final Flow Recommendation Report; the draft and final 1998 Synthesis Report, and any other reports that are produced as end products of the Program. They will also be asked to assist the Biology Committee in developing a long term monitoring program, and will be asked to review 1999 Work Plans. Their reviews will be provided to the Biology Committee through Dr. Paul Holden in letter form, and through discussions at the Biology Committee at meetings. Biology Committee researchers may call Peer Review Panel members to ask for advice, and Peer Review Panel members may call Biology Committee researchers if they have questions concerning Program activities. All correspondence between the Biology Committee and the Peer Review Panel will be coordinated through Dr. Paul Holden, who will maintain a record of these coordination activities for the Program. Additional Peer Review Panel members may be added if a particular expertise is needed by the Biology Committee.

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Mr. Ned Andrews
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Denver, CO
Phone: 303-541-3002
FAX:
email:

Budget:

Payment for serving on the Peer Review Panel includes expenses for travel to and from meetings, and for non-federal personnel (Hubbs, Wohl, Ryel) an honorarium. The honorarium would be sized dependent on the activities of the Peer Reviewer. For example, in 1997 an honorarium of $1,000 was provided for services related to a meeting with the Biology Committee and discussing the flow recommendation process, and reviewing the draft Flow Recommendation Report. In 1998, it is expected that the level of review, be it through meetings or review of documents, may be at least twice as extensive as the 1997 services. Hence, honoraria of $2,000 per Peer Reviewer may be more appropriate. In anticipation of increased honoraria, and three meetings with the Program, the following budget is proposed.

Honoraria:	$6,000.00	
Travel:	$9,000.00	($600/meeting x 5 people x 3 meetings)
Total	$15,000.00	

PROGRAM MANAGEMENT
1998 WORK PLAN

U.S. Bureau of Reclamation
Larry Crist - Principal Investigator

Background:

Program Management funds are not used to support a specific study or project. Funds reserved for Program Management are used to provide staff time to support individual studies as requested, administer funding agreements and participate in and support Program committees. The bulk of these funds are allocated to Reclamation's Grants and Cooperative Agreements staff, Upper Colorado Regional Office Environmental Resource Group and the Durango Area Office. During 1997 activities conducted by Reclamation included participation in the Recovery Program Committees, coordination of water operations and research activities, and administration of agreements with cooperating agencies. Management funds are important to insure that Reclamation's contributions to the program are properly administered and that funds are transferred in a timely and efficient manner.

Objectives:

1.) Administer and modify as needed existing Intraagency agreements with; U.S. Fish and Wildlife Service Region 6, U.S. Fish and Wildlife Service Region 2, and the USGS.

2.) Administer and modify as needed existing Cooperative Agreements with; the states of New Mexico, Utah, Colorado, and the University of New Mexico at Albuquerque.

3.) Administer and modify as needed Service Agreement with U.S. Bureau of Reclamation, Remote Sensing Branch for required services.

4.) Distribute Bureau of Indian Affairs contributions to research program through existing agreements.

5.) Implement additional Cooperative Agreements or Interagency Acquisitions as needed.

6.) Provide staff support as needed to field studies.

Budget:

Personnel	$ 26,000
Travel/Per Diem	$ 4,000
TOTAL	$ 30,000

PROGRAM COORDINATION
FISCAL YEAR 1998 WORK PLAN PROPOSAL

Principals: Joe Dowhan and Jim Brooks
U.S. Fish and Wildlife Service, Albuquerque, New Mexico

Background:

The San Juan River Recovery Implementation Program (SJRRIP) is designed to simultaneously address endangered fish species recovery and development of water resources within the Basin. The SJRRIP includes representatives from not only the above mentioned federal agencies, but also the states of Colorado and New Mexico, the Jicarilla Apache Tribe, the Southern Ute Tribe, and the Ute Mountain Ute tribe which all have legal mandated responsibilities to the endangered fish and/or the water resources. The SJRRIP includes three committees. The Coordination Committee, chaired by the Regional Director for Region 2, Albuquerque, functions as the oversight committee, determining policy and reviewing products of the Biology and Navajo Dam Operating committees. The Biology Committee is responsible for developing work plans for answering technical questions regarding recovery and development of San Juan River resources, conduct of studies, reporting of study results, and development of a Long range Implementation Plan to guide research and management efforts. The Navajo Dam Operating Committee serves in an advisory role, primarily to the Biology Committee, to coordinate flow requests designed to address research needs. The current focus of the SJRRIP, as outlined in the Long Range Plan completed in 1994, is to integrate research information and develop initial flow recommendations regarding reoperation of Navajo Dam. The time line calls for issuance of flow recommendations by mid 1998.

The Service has appointed a Program Coordinator who assists the Biology Committee with conduct of research and management activities through the Long range Plan and with presentation of annual research findings to the Coordination Committee and the draft work plan for the succeeding program year. The coordination role also includes facilitation of meetings, printing of research reports and information dissemination for the SJRRIP.

Budget:

Personnel	$ 27,500
Travel/Per Diem	$ 3,000
Meetings, supplies	$ 2,000
Printing/publication	$ 7,500
Subtotal	$ 40,000
Administrative Overhead	$ 7,100
TOTAL	$ 47,100

COLLECTION OF LARVAL RAZORBACK SUCKER FROM LAKE MOHAVE FOR USE IN AUGMENTATION EFFORTS IN THE SAN JUAN RIVER FISCAL YEAR 1998 PROJECT PROPOSAL

Principal Investigators: Dale Ryden and Frank Pfeifer
U. S. Fish and Wildlife Service, Grand Junction, CO

Background:

In August 1997, a Five-Year Augmentation Plan for Razorback Sucker in the San Juan River was finalized. Stocking of razorback sucker from various sources into the San Juan River began in early September 1997. The five-year plan called for 31,800 razorback sucker to be stocked into the San Juan River in Year 1. Between 3 and 19 September 1997, a total of 2,885 razorback sucker were stocked into the San Juan River at Hogback Diversion, New Mexico. Numbers of razorback sucker available to the San Juan River Recovery Implementation Program (SJR-RIP) for 1998 and outyears of the five-year augmentation effort are limited and will not be able to fulfill numbers specified in the plan for fiscal year 1998. The only source presently available for making up the shortfall in desired numbers of stocked fish is Lake Mohave. During spawning season in Lake Mohave, large numbers of larval razorback sucker can be collected in a very short time by dipping the larvae as they are attracted to lights suspended from boats. Collection of larval razorback sucker and transport to either a suitable grow-out pond in the Farmington, New Mexico area, or Wahweap Warmwater Fish Hatchery (UDWR) near Page, Arizona will allow the SJR-RIP to obtain a large number of razorback sucker for use in the five-year augmentation effort for this species.

Objectives:

1.) To obtain larval razorback sucker to be raised in either a grow-out pond or hatchery facility, for later use in the five-year augmentation effort for razorback sucker in the San Juan River.

Methods:

Members of the U.S. Fish and Wildlife Service's Colorado River Fishery Project Office in Grand Junction, Colorado will assist in the annual collection of larval razorback sucker in Lake Mohave. Collected larval fish will be transported via stocking truck to appropriate facilities in either the Farmington, New Mexico area or Wahweap Warmwater Fish Hatchery (UDWR) for rearing to a stockable size.

Handling and transport of larval razorback sucker will follow existing U. S. Fish and Wildlife Service protocols.

The Service will have the lead for the collection of larval razorback sucker. Other cooperating agencies may provide personnel and equipment if needed.

Budget FY-98:

Labor	$ 6,000
Travel-Per Diem	$ 1,000
Equipment and Supplies	$ 3,000
Subtotal	$ 10,000
Service Admin. Overhead (19.00%)	$ 1,900
TOTAL	$ 11,900

DETERMINING RATES OF DOWNSTREAM TRANSPORT OF DRIFT IN THE SAN JUAN RIVER WORK PLAN AND BUDGET 1998

Submitted by

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Background:

That Colorado squawfish drift for a portion of their early life history has been well documented by numerous studies throughout the Upper Colorado River Basin. Larval drift studies in the San Juan River (1992-1997) have documented dispersal of this and other species via drift. We are not currently aware of the distance that this or other species may travel during this phase of their life history. While the distances aquatic organisms are transported downstream are dependant on a myriad of factors (water temperature, velocity, channel morphology, fish behavior, growth-rate), generalized models can serve to provide preliminary information on the impacts of drift to recruitment and population survival.

The San Juan River population of Colorado squawfish is believed to congregate for spawning at one or two locations. Larval drift studies verify that one spawning bar occurs in New Mexico and a second is believed by some to exist further downstream in Utah. The limited number of larval Colorado squawfish collected during these studies hinder our ability to make predictions regarding their rate of downstream transport. We propose to release millions of artificial eggs that will closely mimic the downstream movement of drifting larval fish and provide a preliminary quantitative assessment of the distance drifting fish travel under a given flow scenario. This information will provide a means of assessing the disposition of drifting Colorado squawfish and may indicate what proportion of the reproductive effort ends up in Lake Powell.

Introduction:

As the primary attribute of interest of drift are their buoyancy, that feature was deemed the most important in the man-made eggs. The most appropriate measure of the buoyancy for material to be used for the production of artificial eggs was specific gravity (i.e., density [g/cm^3]). This relative measure of an object is dependent on the physical properties of liquid in which the item is immersed. Measures of specific gravity are often standardized to pure water at 3°C (SG=1.00). The specific gravity of materials tested for this study, including natural fish eggs, was determined in a column of water.

Specific gravity is largely a function of the terminal velocity an object reaches traveling vertically through a liquid. Materials that are more dense than water accelerate from 0 cm/second to a constant velocity known as its "terminal velocity". Terminal velocity is largely determined by an object's density and can only be measured after the object has stopped accelerating. Inclusion of measures preceding the terminal velocity result in an underestimation of the density of the material. Relatively minor differences in density between materials (e.g., 1.05 g/cm^3 versus 1.01 g/cm^3) result in very noticeable differences in sinking rates. While 0.04 g/cm^3 appears an insignificant difference between materials, it greatly affects the rate at which the material will settle to the bottom.

The terminal velocity of an object is also affected by the kinematic viscosity of the fluid through which it is traveling. Temperature and chemical composition of the liquid are important in determining its kinematic viscosity. The viscosity of most fluids (e.g., water, ethyl alcohol and glycerine) decrease with increased temperatures. Generally, fluids that are more dense are more affected by changes in temperature. The kinematic viscosity of water is subject to changes in temperature, but not to the degree of more dense fluids. The viscosity of a liquid is a key variable that determines the rate at which an object travels in that fluid (i.e., terminal velocity). The higher the viscosity, the lower an object's terminal velocity.

The shape and size of the material traveling through a column of water also determines its terminal velocity. Small objects are more subject to the influences of drag and, thus, fall at slower rates than same-density but larger objects. This phenomena is largely due to the decreased ratio of surface area to mass that characterize smaller objects. As an object (e.g., spheres) increases in size, the surface area increases at a much slower rate than the mass. With a lower amount of surface area relative to increased mass there is only a slight increase in drag. However, the increase in mass creates a much larger gravitational force than the drag force. The result is that larger spheres fall more rapidly through a liquid than smaller same-density spheres. This is due primarily to the inequalities of the drag and gravitational forces.

The shape of an object also affects how rapidly it falls through a liquid. A small surface area to mass ratio results in less drag than a high ratio. In addition, a round edge creates less drag than a square one. Despite these differences, the moderate alterations in the shape of the object usually does not result in large changes in the terminal velocity (i.e., spheres versus cylinders). However,

radical differences in shape (e.g., flat rectangle versus sphere) may result in large changes in the terminal velocity compared to objects having the same mass and density.

Because many factors influence the terminal velocity of same-density objects falling through a liquid, testing the specific gravity of a material was only the initial test to determine the feasibility of materials that may mirror physical properties of semi-buoyant fish eggs. The experimentally determined terminal velocity was ultimately the most important variable. This test also allowed for a relatively rapid comparison between materials and natural eggs regardless of the manufacturer's supplied values of specific gravity.

In addition to an object's terminal velocity, the behavior of that material in current was also examined. Minor currents can greatly affect objects in suspension that have very low terminal velocities. Because objects with low terminal velocities in water have similarly small gravitational forces pulling them toward the bottom, the amount of force needed to keep them in suspension (i.e., against gravity) is also small. Water currents in lotic systems are sufficient to keep most drifting larval fish in suspension. Only in areas where flows are relatively non-existent or absent (e.g., certain areas in pools or backwaters) will larvae have an opportunity of coming out of suspension. Even in these areas, the influences of water temperature, water chemistry or the occasional wisps of current can quickly bring the larvae back into suspension.

The behavior of an object to current is largely based on its specific gravity, but its size is also an important factor. As previously stated, objects with the same density may have different terminal velocities due to differences in their size. Using this same argument and underlying properties, objects of differing densities may have the same terminal velocity based on their size. If terminal velocity was the only criteria used to mirror the physical parameters of semi-buoyant fish eggs, many materials with varying densities could be used. However, to use materials that are more dense, the size of the object must be small. Corresponding increases in density require smaller and smaller objects if the terminal velocity is to remain constant. However, the effects of water current on small versus large objects with the same terminal velocity are not the same. Larger objects have a larger surface area for the current to strike and, thus, are more subject to the force contained in the current. In low current, the smaller objects will settle to the bottom more quickly than will the larger objects.

In testing and developing a material that could act as an "artificial egg" and mimic drift, we also conducted field observations of the product in the river and aquaria. Field observations included releasing small amounts of the test material into the river and then observing its dispersal. Aquaria were used to test reactions of fish to artificial eggs. These tests, combined with the laboratory experiments, provided the information necessary to make informed decisions as to which material best mimics the physical parameters of drift.

Field observations of the potentially usable materials were made by releasing small quantities into the river. Observations were made on the differences in rates of travel between objects that floated and those that remained submerged. Materials were tested to see if they remained in the

water column or traveled along the bottom during low to moderate flows by setting drifts nets under the surface of the water and well above the substrata. Observations on how the materials dispersed throughout the river channel as they drifted downstream were made by walking along the bank and in the river at the rate that the materials were traveling. Further observations were made following the release of the materials to see how frequently they were isolated in areas of low flow or along the shoreline.

We tested the possibility of fish ingestion of some of the most promising materials by putting a known number of the particles of a particular product into an aquarium with Pecos River fishes. The behavior of the fishes to the product was observed for several minutes. Additionally, the fish and particles were isolated together in the aquarium for a period of one week and checked daily to see if any of the particles had been ingested. The particles of different products were kept in different tanks.

Results:

Objects dropped into the column were found to accelerate quickly to their terminal velocity. Once the object reached its terminal velocity (i.e., no acceleration) it would be appropriate to measure its speed. However, we found there was some variation between materials in how long it took for them to reach terminal velocity. We purposely located our start point (30 cm below top of column) well beyond the point at which the object would hit its terminal velocity. This precaution was taken for all materials tested so that an accurate measure of its speed or relative buoyancy could be assessed.

The physical parameters for fish eggs were calculated based on at least 20 trials. The mean diameter of eggs was 2.672 $\pm$ 0.022 mm. The specific gravity of fish eggs (SG=1.00565 $\pm$ 0.00015) at 20 C was found to be very close to water (SG=1.000). The difference of only 0.006 g/cm^3 between the effective densities of water and fish eggs meant that eggs were only slightly negatively buoyant. Thus, the terminal velocity of eggs was also low (U= 9.058 x 10^{-3} m/s $\pm$ 0.168). The average time it took eggs to travel a distance of only 70 vertical centimeter was one minute and 18 seconds.

We located several products which absorb many times their own weight in water making them only slightly negatively buoyant. Polyurethane foam had a low terminal velocity, similar to fish eggs, and remained in suspension at low currents generated in the aquarium. Field experiments using polyurethane foam demonstrated that the product remained in suspension and behaved similarly to fish eggs as it drifted downstream. Similar results to the polyurethane foam were also noted for a polyacrlyamide gel manufactured by Agro Innovators International, Inc., Arlington, Texas. The particular type of product we found appropriate was called "Agrosoke-SK100" and was a special synthetic variant of the more commonly manufactured "Agrosoke". Agrosoke-SK100 is a crystal linked homopolymer of acrylamide and consists of amide groups (-$CONH_2$-) linked to CH groups. The CH groups are connected in an alternating pattern to CH_2 to give the product is chemical structure. This material absorbs many hundred times its weight in water

swelling from a small hard crystal to a large flexible gel-like material. The Agrosoke-SK100 had a similar terminal velocity as fish eggs and behaved appropriately in the aquarium and field tests.

In addition to products that absorbed or swelled with water to mimic the physical parameters of semi-buoyant fish eggs, we also located some solid materials (i.e., no water absorption) that approximated the properties of eggs. There were several materials that we located whose specific gravity was close to that of eggs (SG range= 0.97 to 1.01). These materials were all nylon thermoplastics with the product name "Grilamid". The grilamid products we were most interested in were in the polyamide chemical family. As the name implies, the chemical structure of polyamides (many amino) is basically an aggregation of many CH_2 groups linked in a circle and ultimately joined by a single link; the amide (also called peptide or protein) bond (-CONH-). The nylon 12 polyamide has a specific gravity of 1.01 unmodified. Nylon 12 is like other polyamides (e.g., nylon 6) with the exception that it has a circle of 12 CH_2 groups before it is joined by a single peptide bond. Variations in the specific gravity of Grilamid are obtained by the addition of "impact modifiers" which reduce the density of the material. The impact modifier used is a trade secret but is non-toxic. All nylon products that were tested were small extruded cylinders measuring about 2 mm in diameter and 2.5 mm in length.

The unmodified (SG=1.01) Grilamid was found to behave similarly to fish eggs, but its terminal velocity in the water column experiments was higher than the eggs. The vertical rate of travel for the unmodified nylon 12 was about 1½ times the rate measured for the fish eggs. This difference was visually apparent and meant that all pieces of the nylon 12 reached the bottom more rapidly than any of the eggs. This was despite the fact that the difference between the estimated specific gravities of the nylon 12 and fish eggs was only 0.00435 g/cm^3. In the aquarium experiments, it was possible to segregate the nylon 12 from the fish eggs by using very low flows. Under these conditions fish eggs remained in suspension while the nylon 12 pellets were found to touch the bottom of the aquarium and occasionally re-enter suspension. However, at some of the lowest currents we were able to generate, the fish eggs all still remained in the water column while almost all of the nylon pellets sank and remained on the bottom. In field observations, the nylon 12 remained in the water column and was collected in drift nets. However, the product was found to settle out in very low velocity areas such as shallow pools and backwaters.

One type of the modified (SG=1.00) Grilamid was found to behave similarly to the fish eggs in all the experiments we conducted. While the published value for specific gravity of this product is 1.00 at 3 C, all experiments were conducted at about 20 C. Thus, the SG between the product and water at this temperature changed and was about 1.00. This meant that the pellets, like the eggs, would very slowly sink to the bottom. Thus, the terminal velocities between the eggs and pellets differed only slightly and the range of terminal velocities exhibited by fish eggs included the mean value for the modified nylon 12.

In addition to testing plastics with published specific gravities of about 1.00, we also tested plastics whose specific gravity was higher (SG>1.01). The primary material tested was a polystyrene thermoplastic polymer (SG=1.04). The polymeric beads we tested were very small (diameter ≈

1 mm). Larger particles of polystyrene that approached the size of fish eggs were used in initial experiments, but were found to have a high terminal velocity. The small beads had a much slower terminal velocity and nearly matched the terminal velocity of fish eggs. However, in aquarium experiments the small beads were found to settle to the bottom at lower currents than did the eggs. Because of this discrepancy, the polystyrene beads were tested no further and were not used in field experiments.

The final category of materials tested had specific gravities of < 1.00 (i.e., floating). The primary material used was an expanded polystyrene thermoplastic polymer "Styrofoam". The Styrofoam beads used measured from about 2 to 3 mm in diameter. In the field experiments, the beads were found to be affected by surface winds and were often stranded along the shoreline or amongst partially exposed instream debris. The only other floating material tested was also a Grilamid. While the material normally remained in suspension, some of the beads could be made to float if small air bubbles formed along the surface of the material. We found that the beads that floated traveled downstream at much higher speeds than did the submerged beads. When sampling downstream of the area where the beads were released, many of the floating particles passed the sampling location before any of the submerged particles did. Similarly, virtually no floating particles were observed during the time when the final portion of the submerged beads were collected.

In experiments where particles were released into tanks with fishes, we found that none of the materials appeared to cause any problems for the fishes. We tested what we felt were the most promising materials, but found that none of the particles of either product had been ingested by the fishes over a one week period. Both products were acknowledged by the fish and occasionally individuals would draw the object into their mouths. However, the fish appeared to recognize both products as non-food items and quickly spit the object of their mouths. This behavior was only noted when the products were first introduced into the cages and did not appear to happen with any consistency after this.

Objectives:

1.) Determine the transport rate of drift within and between selected reaches of the San Juan River between Cudei Diversion and Lake Powell

2.) Provide preliminary assessment of impacts of downstream transport on Colorado squawfish juvenile recruitment

3.) Correlate rates of downstream transport with hydrology and river morphology

Methods:

1.) Select between three and five release sites between Cudei Diversion (RM 140) and Mexican Hat (RM 55). Use different color artificial eggs for each of the different sites.

2.) Establish downstream-most collection station at Mexican Hat. Include Four Corners drift netting station as one of the sampling localities.

3.) Simultaneously release artificial eggs at each of the selected sites during early August when proto larval Colorado squawfish are believed to be beginning the drift phase of their life history. Coordinate efforts with teams monitoring the drift below putative Colorado squawfish spawning bars. There will be only one release for this study.

4.) Perform continuous collection of artificial eggs in 15 minute intervals. Determine catch per unit effort based on the number of eggs per m^3 sample.

5.) Retain and preserve all larval fish incidentally collected during the this study.

6.) Data will be converted to catch rate and compared across river reaches. Transport rate within and between reaches will be determined and compared.

Budget:

TRANSPORT STUDY

Personnel	$	5,000
Travel and Per Diem	$	1,100
Subtotal	$	6,100
Overhead on salary/travel (15%)	$	915
Total (without eggs)	$	7,015
Artificial eggs 14 bags@$350/bag (excluded from overhead)	$	4,900
GRAND TOTAL	**$**	**11,915**

SAN JUAN RIVER LARVAL RAZORBACK SUCKER SURVEY
WORK PLAN AND BUDGET 1998

Submitted by

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Background:

In 1994, a total of 672 razorback sucker were stocked in the San Juan River between Bluff, Utah and the Hogback, New Mexico. Mean length and mass of those individuals, at the time of stocking, was about 400 mm TL and 710 g, respectively. In 1995, 13 of the recaptured razorback sucker were tuberculate males and six of those individuals were ripe. Four recaptured 1995 razorback sucker were determined to be female but, unlike the males, none were sexually mature. In their 1995 report of activities, Ryden and Pfeifer (1996) suggested that the majority of the experimentally stocked San Juan River razorback sucker reached sexual maturity in 1995-96 and that spawning of these individuals might begin in the next two years.

At the November 1996 San Juan River Biology Committee integration meeting, it was suggested that we expand a portion of our larval fish drift study to allow for documentation of razorback sucker spawning. In other portions of the Colorado River basin this species reproduces at least one month prior to Colorado squawfish. We know, from other Upper Colorado River basin researchers, that one of the best means of collecting larval razorback sucker is through the use of a passive collector that makes use of the fact that larval fish are attracted to light. The traps (light traps) are set after dark and retrieved before dawn. The light is barely visible as it is only 2.25 volts and takes only two D-cell batteries to provide illumination. Once submerged, only the

Styrofoam top of the trap remains visible. For these traps to operate efficiently, they need to be set in very still waters (as opposed to drift nets which require flow).

Our previous experience with light-trap sampling in the San Juan River indicates that this collecting technique can produce an extremely large number of specimens. In 1994, we sorted over 25,000 larval fish from about 20 light-trap samples, of which over 99% were red shiner. The 47 light-traps samples taken in the San Juan River arm of Lake Powell in 1995 (August 8-10 and 15-17) produced 25,455 specimens. As in 1994, red shiner numerically dominated the 1995 catch.

From late March through mid-June 1997, light traps were set nightly in low-velocity habitats between Aneth and Mexican Hat. The traps were set at dusk and retrieved about four hours later. Fish were preserved for identification at a later date. Our sampling success in 1997 was quite poor. While there were over 200 light-trap sets, those sampling efforts produced only 297 fish. Of those, about 200 (66%) were larval suckers (the specific identity of those individuals are still being determined).

While there were probably several factors that accounted for the poor light trap catch rate, a principal factor was the limited access we had to suitable habitats. Light traps are most effective when set in habitats with little or no water velocity. During our driving survey of riverine habitats in the region (March 1997), we identified numerous locations that appeared to be suitable sites for light trap. However, we found that high flow in the San Juan River eliminated virtually all previously identified low velocity habitats. Further driving reconnaissance failed to yield additional locations to set light traps. Being tied to specific collecting sites was not the most efficient means of collecting large numbers of individuals. We have suggested changes in 1998 sampling techniques that should result in the collection of more specimens and provide better representation of the catostomid community.

Objectives:

1.) Determine the temporal distribution of San Juan River ichthyoplankton in relation to the hydrograph

2.) Provide comparative analysis of the reproductive success of San Juan River fishes

3.) Attempt to characterize downstream movement of ichthyoplankton

4.) Attempt to validate presumed spawning period of San Juan River catostomids.

Methods:

1.) Sample the San Juan River between Four Corners (RM 119) and Mexican Hat (RM 55) from mid-March through mid-May.

2.) Access to the river shall be acquired with either rafts or canoes. Sampling of the 60 mile reach will be conducted on a 7-10 day (approximately) cycle.

3.) Larval fish will be collected from low velocity habitats with small mesh seines. Specimens will be preserved in the field for future laboratory processing. Habitat type, length, maximum depth and substrate will be recorded. Catch per unit effort will be determined as the number of fish per m^2 sample.

4.) Light traps (1-5) will be set at in selected low velocity habitats. Traps will be set after dusk in a low-velocity non-mainstream habitat and remain there for about four hours. Light-traps will be set every other night. Catch rate will be determined as the number of fish collected per time sampled.

5.) Data will be converted to catch rate and compared across and within sites by species. In addition, catch rate between and within sites will be compared across time (1996 samples). Specimens will be distinguished and compared by residence status (native versus non-native) and catch rate over-laid with the annual hydrograph.

Budget:

RAZORBACK SUCKER

Personnel	$ 10,000
Travel and Per Diem	$ 3,000
Equipment and Supplies	$ 1,000
Subtotal	$ 14,000
Overhead (15%)	$ 2,100
TOTAL	**$ 16,100**

EVALUATION OF THE EFFECT OF ELEVATED FLOWS ON SPAWNING SUCCESS OF RED SHINER, *CYPRINELLA LUTRENSIS*

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New Mexico Department of Game and Fish
And
Museum of Southwestern Biology
University of New Mexico

Background:

The red shiner, *Cyprinella lutrensis*, is native to central and southern Great Plains streams of the Mississippi-Missouri and Gulf Coastal drainages (Matthews, 1980). It was first documented in the Colorado River basin near Yuma, Arizona in 1953 (Hubbs, 1954). Since then, the species has become widespread and common in the basin and has been implicated in the decline of several native fishes (Minckley and Deacon, 1968; Douglas et al., 1994; Ruppert et al. 1993). In the San Juan River of New Mexico, Colorado, and Utah, red shiner is one of the most common nonnative fish species, particularly in low velocity habitats (Archer et al., 1996; Propst and Hobbes, 1996). These low velocity habitats (backwaters and embayments) are also important nursery areas for larval Colorado squawfish (Haynes et al., 1984; Archer et al, 1996). Low numbers of larval (Age 0) Colorado squawfish have been captured during most years (1992-1996) of the San Juan River Seven-Year Research Program in low-velocity habitats associated with the San Juan River Primary channel (Archer et al., 1996). Although San Juan River secondary channels, after cessation of spring runoff, have mainly low-or zero-velocity habitats, no larval Colorado squawfish was captured in secondary channels prior to 1996 (Propst and Hobbes, 1996).

In November 1996 and August 1997, large numbers of Age 0 Colorado squawfish were stocked in the San Juan River in an effort to determine what factors might be limiting recruitment of young Colorado squawfish to the adult population (UDWR 1997 Work Plan). Following their stocking, UDWR personnel regularly sampled low velocity habitats to assess Age 0 Colorado squawfish survivorship and characterize the habitats they used (E. Archer, pers. comm.). In addition to being found in low-velocity habitats associated with the primary channel, stocked Colorado squawfish were also found in secondary channels. During the autumn 1997 secondary channel monitoring, 240 Age 0 Colorado squawfish were found in 20 secondary channels.

In the San Juan River, backwater habitats associated with the primary channel, typically represent a small proportion of the total wetted area available as habitat to fishes (Bliesner and Lamarra, 1996). After cessation of spring runoff, secondary channel habitats are primarily low-velocity and provide comparatively large (surface area) potential nursery habitat for Colorado squawfish. Prior

to stocking Age 0 Colorado squawfish in 1996, the apparent absence of the species in secondary channels may have been precluded by the high abundance of nonnative fishes, particularly red shiner, in these habitats. One possible explanation for the high abundance of red shiner in secondary channel habitats (as well as primary channel backwaters) is the ability of an individual female to spawn numerous times over a season, if water temperatures are within the appropriate range (>25 and <35° C; Gale, 1986). Red shiner spawning in San Juan River secondary channels was noted at temperatures between 20 and 25°C (D. L. Propst and K. B. Gido, unpublished data), but most spawning appeared to occur when water temperature was within the range reported by Gale (1986). If red shiners have an extended spawning season in San Juan River secondary channels, this should be reflected in the capture of small larvae (<12 mm SL) for an extended time (ca. 60 to 80 days). However, data from intensively sampled secondary channels indicate that the spawning season for red shiner in the San Juan River is brief. At the Channel from Hell (RM 136) site, Age 0 red shiners were first collected in late-July 1993 and 1994. Length-frequency histograms (Figure 1) indicated that the 1993 spawning likely occurred from the second or third week of July through early September (ca. 60 days), but that most spawning occurred during a brief period in late July-early August (ca. 15 days). Data from 1994 indicated that most spawning occurred over a similar or briefer time frame (Figure 2). Fewer red shiner specimens were collected in 1995, but data for that year also suggested a brief spawning season (Figure 3). Greatest density of red shiner at the Channel from Hell site occurred in 1993 when discharge in the channel was very low throughout the presumed spawning season (Figure 4a). Spring runoff in 1994 was comparatively low and red shiner density increased with successful spawning and recruitment. In 1995, high spring runoff apparently decreased red shiner density and reduced spawning success. Water temperatures at the Channel from Hell site exceeded 25°C for only 3 weeks or less in 1993, 1994, and 1995 (Figure 4b). Although Gale (1986) found a strong correlation between red shiner spawning and water temperature and such appears to be indicated by the foregoing data, photoperiod may also influence time of maximum spawning activity (C. Hubbs, pers. comm.).

The above provides evidence to support the contention of Gido et al. (1997) that spring runoff tends to reduce the abundance of nonnative fish in secondary channels. However, even high spring runoff does not eliminate nonnatives. The survivors spawn, and can potentially regain abundance (presumably as a consequence of increased survivorship of Age 0 fish) similar to that prior to high spring runoff.

Although high spring runoff appears to be an important factor in suppressing nonnative abundance, data on the red shiner population in the Channel from Hell suggest it is sufficient only for temporary and short term reductions. Given the documented problems that red shiner (as well as other nonnative fishes) presents to native fishes, particularly those that use low-velocity nursery habitats, additional means to suppress nonnative abundance are needed. The data from the Channel from Hell site suggest that flow spikes during the spawning season of red shiner (preferably in concert with high spring runoff) would contribute to greater reduction in the abundance of the species (Figure 5). A correctly-timed flow spike would reduce water temperature below optimal spawning temperature and flush larval red shiner from nursery habitats.

Ideally, this reduction would be sufficient to reduce red shiner sufficiently that it would not be a problem for larval Colorado squawfish the following year.

A potential problem with a flow spike of sufficient intensity to reduce red shiner spawning success would be its occurrence when larval Colorado squawfish are susceptible to displacement. Conversely, if survival of larval Colorado squawfish is impaired by high densities of red shiner, a flushing or spawn delaying flow spike would not diminish the ultimate survival of Colorado squawfish in the San Juan River. Red shiner is a short-lived species (maximum longevity <30 months) and populations of such species must successfully spawn at least every 2 years to survive. Colorado squawfish, however, is a long-lived species (>25 years) and may not have to spawn successfully each year to maintain population viability.

The results of a study such as that proposed herein have implications for the management of undesirable nonnative fishes. If summer flow spikes are demonstrated to have deleterious effects upon red shiner density, particularly in low-velocity habitats, a management option may be to make reservoir releases to mimic summer storm caused flow spikes. A critical issue for such a management option is the volume of water needed to cause the desired effect. This study is designed to identify the threshold flow spike (and thus the volume of water) sufficient to significantly reduce red shiner abundance. During "dry" years, a decision may be made to not use limited water supplies to mimic spring runoff, but to use the available water to reduce red shiner abundance during their spawning season.

Study Objective:

The overall study objective is to determine if summer storm-caused flow spikes significantly reduce red shiner spawning success and abundance. Data from this study will be used to evaluate the efficacy of using summer reservoir releases to reduce red shiner abundance.

The specific objectives of the study are:

1.) Document the response (spawning success and survival of larvae) of red shiner to elevated flows during its spawning season.

2.) Estimate the volume and duration of elevated flows required to have a demonstrable negative impact on red shiner spawning success and abundance.

3.) Characterize response of other nonnative and native fishes to elevated flows at each study site.

4.) Prepare report (using appropriate uni- and multivariate statistical procedures) detailing results of study and use this information to make recommendations to improve the management of nonnative fishes particularly red shiner, in the San Juan River.

Methods:

Study sites will be located on secondary channels at RM 136 and 128.5 (also used in the Gido et al., 1997 and Gido and Propst, in press, studies). Each site will contain a representative mix of mesohabitats (e.g., pools, riffles, and runs). Thermographs will be installed at each site prior to cessation of spring runoff (early June to early July) and will be checked once every 5 days until water temperature is >20°C for at least 4 hours during daylight hours. Within 3 days of water temperature reaching this standard (and no later than 20 July), the fish community at each site will be sampled weekly through 30 September by mesohabitat, following the protocol of Gido et al. (1997). All specimens will be preserved (10% formalin), measured (± 1 mm TL), and a subsample of female red shiners collected at each site will be examined to characterize gonadal condition. At least four of each mesohabitat present within each site will be sampled on each site visit; a minimum of 12 mesohabitats will be sampled at each site. Specimens collected from each mesohabitat will be preserved separately. Surface area, mean depth, and mean water velocity will be determined for each sampled mesohabitat. Secondary channel discharge will be determined for each secondary channel during each site visit. Time of maximum spawning activity will be related to accumulated degree-days and photoperiod.

During each year of the study, natural flows will be depended upon to assess their relative effect on red shiner spawning and recruitment success. The sampling schedule will be modified, if necessary, to ensure that the first post-flow spike samples is within 36 hours of return to base flows at each site. At least four post-flow spike samples will be taken at each site. The USGS WWW site (real-time water data pages for New Mexico and Utah) will be monitored daily to determine when a storm-caused flow spike will likely occur at the study sites. The proposed sampling schedule provides adequate flexibility to ensure timely sampling around flow spikes.

Data collected during the 1993-1996 secondary channel community dynamics and habitat association studies will be used to augment that obtained in this study.

During the second and third study years, the same protocol will be followed. For each year, optimal study conditions would include a range of natural summer flow spikes during the presumed peak spawning season of red shiner. However, absence of a flow spike in a particular year would not negate the value of the data collected. A continuum of summer flow patterns from no flow spike through one as high as that during summer 1997 would enable enhanced resolution of the relationship between summer flows and red shiner abundance.

Field work is proposed for 3 years. Data compilation, data analysis, and report preparation will be completed during the fourth year. Although the focus of this study is to characterize the response of red shiner to summer flow spikes, the sampling methodology enable collection of data on all species (native and nonnative) that inhabit secondary channel habitats during summer. These data may also be analyzed to provide insights to the response of these species to summer flow spikes.

Literature Cited:

Archer, E., T. Chart, L. Lentsch, and T. Crowl. 1996. Early life history fisheries survey of the San Juan River, New Mexico and Utah, 1995. San Juan River Recovery Implementation Program, Annual Research Report, Fiscal Year 1995. U.S. Fish and Wildlife Service, Albuquerque, NM.

Bliesner, R. and V. Lamarra. 1996. San Juan River habitat studies, 1995 Annual Report. San Juan River Recovery Implementation Program, Annual Research Report, Fiscal Year 1995. U.S. Fish and Wildlife Service, Albuquerque, NM.

Douglas, M. E., P. C. Marsh, and W. L. Minckley. 1994. Indigenous fishes of western North America and the hypothesis of competitive displacement: *Meda fulgida* (Cyprinidae) as a case study. Copeia 1994: 9-19.

Gale, W. F. 1986. Indeterminate fecundity and spawning behavior of captive red shiners--fractional, crevice spawners. Transactions of the American Fisheries Society 115:429-437.

Gido, K. B., D. L. Propst, and M. C. Molles, Jr. 1997. Spatial and temporal variation of fish communities in secondary channels of the San Juan River, New Mexico and Utah. Environmental Biology of Fishes 49:417-434.

Gido, K. B. and D. L. Propst. in press. Habitat use and associations of native and nonnative fish in the San Juan River, New Mexico and Utah. Copeia 1998:00-00.

Haynes, C. M., T. A. Lytle, E. J. Wick, and R. T. Muth. 1984. Larval Colorado squawfish (*Ptychocheilus luscius*) in the Upper Colorado River basin, Colorado, 1979-1981. The Southwestern Naturalist 29:21-33.

Hubbs, C. L. 1954. Establishment of a forage fish, the red shiner (*Notropis lutrensis*), in the lower Colorado River system. California Fish ad Game 40:287-294.

Matthews, W. J. 1980. *Notropis lutrensis* (Baird and Girard) red shiner. P. 285 In D.S. Lee, C. R. Gilbert, C. H. Hocutt, R. E. Jenkins, D. E. McAllister, and J. R. Stauffer, Jr. (eds.). Atlas of North American freshwater fishes. North Carolina State Museum of Natural History, Raleigh, NC.

Minckley, W. L. and J. E. Deacon. 1968. Southwestern fishes and the enigma of "endangered species." Science 159:1424-1433.

Propst, D. L. and A. L. Hobbes. 1996. Ichthyological characterization of San Juan River Secondary channels, 1995 annual report. San Juan River Recovery Implementation Program, Annual Research Report, Fiscal Year 1995. U.S. Fish and Wildlife Service, Albuquerque, NM.

Ruppert, J. B., R. T. Muth, and T. P. Nesler. 1993. Predation on fish larvae by adult red shiner, Yampa and Green rivers, Colorado. The Southwestern Naturalist 38:397-399.

Fiscal 1998 Budget[1]:

Field Studies	
Personnel	$ 7,000
Travel and Per Diem	$ 2,000
Equipment and Field supplies	$ 4,000
Data Compilation and Analysis	
Personnel	$ 8,000
Annual Report Preparation	
Personnel	$ 2,000
Administrative Support	$ 1,000
Total	$ 24,000
Indirect Costs	$ 2,400
TOTAL	**$ 26,400**

TECHNICAL AND EDITORIAL SERVICES TO COMPLETE THE FLOW RECOMMENDATION REPORT FOR THE SAN JUAN RIVER

Paul B. Holden, Principal Investigator
BIO/WEST, Inc., Logan, Utah
Jicarilla-Apache Tribe
Fiscal Year 1998 Work Plan

Background:

During 1997 the Biology Committee completed a major integration effort to develop flow recommendations for endangered fish in the San Juan River. Four subcommittees were formed to concentrate on developing flow needs for native and non-native small and large fish. This effort will result in a Draft Flow Recommendation Report scheduled to be completed by the end of December, 1997.

An outline for the Flow Recommendation Report was developed by the subcommittees, and assignments were made to various researchers for completion of various components of the report. An obvious need presented by this multiple authorship was to have one person in charge of completing the report, including editing, coordination of figures and tables, printing, distribution, etc. Paul Holden of BIO/WEST, the Jicarilla-Apache Tribe representative on the Biology Committee was given the responsibility to provide overall coordination for the report.

This proposal provides for the funding for the technical, editorial, and production capabilities to complete the draft Flow Recommendations Report by January 31, 1998, and a final version of the report by the end of June 1998.

Goal:

The goal of this proposal is to provide the technical and editorial services necessary to produce a document that accurately shows the process used to develop flow recommendations for the San Juan River and that clearly describes the results of that process.

Methods:

BIO/WEST has worked with the integration subcommittees during the past year as flow recommendations have been developed. BIO/WEST (Dr. Paul Holden) has responsibility for compilation of the entire document, and preparation of summaries of the biological portions of the report. It is anticipated that as the various authors complete their portions of the flow recommendations report that those portions will be forwarded to BIO/WEST. Dr. Holden will review each section for technical completeness and call authors as needed for clarification. He will then forward them to BIO/WEST's Senior Editor for editorial review. The portions of the

document that Dr. Holden is responsible for will be completed as the completed sections are provided to BIO/WEST. The Senior Editor will work with Dr. Holden to assure the various portions of the report are compatible, rewriting as necessary to make a document that is consistent and easy to read. Once the document is final, it will be printed and bound, and mailed to the Biology and Coordination committees, as well as others on the Program mailing list.

Personnel:

Dr. Paul Holden will provide technical review of the document preparation as well as primary authorship of the summary sections assigned to him. Ms. Krista McHugh, BIO/WEST's Senior Editor, will provide the overall editorial review of the document, including any rewriting of sections as needed. Ms. McHugh will use her staff of editors, clerical specialists, and cartographers as needed to assist with document completion.

Primary Contact:

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Budget:

Personnel	$ 16,000
Travel	$ 1,000
Printing and Misc.	$ 3,000
Total	$ 20,000

The Jicarilla-Apache Tribe has been asked to cost share this budget. They are presently considering providing $8,000 of this budget.

ADULT COLORADO SQUAWFISH HABITAT USAGE IN THE SAN JUAN RIVER, SUMMER SPAWNING PERIOD 1998. FISCAL YEAR 1998 WORK PLAN

Principal Investigator: Dr. William Miller, Miller Ecological Consultants
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Background:

One element of the San Juan River Seven Year Research Plan is to determine the habitat requirements of the endangered species in the San Juan River. Determining habitat use is key to understanding the relationship between habitat availability and discharge at various times of the year. This relationship is critical in the recovery process for the endangered species. Understanding that relationship will help to determine if habitat is limiting the endangered species in the river. This work element is a continuation of the 1993 habitat use study. The study will consist of radio tracking implanted fish to determine both the location within a reach of river and the habitat use by those fish. Habitat studies are listed as one component of the adult monitoring studies. As such there will be interaction between the adult monitoring studies and the squawfish habitat studies. There also is direct interaction required between the physical habitat studies and the squawfish habitat use studies. The habitat use information collected in this study and the physical habitat study information will aid in the determination of habitat-flow relationships for the river. Links to these other research elements will require integration of the research findings between the researchers.

The 1998 activities will include additional monitoring during the spawning period. The radio tracking will be conducted for three weeks during summer of 1998. The methods will be the same as those used in the previous habitat use study.

Objective:

The objective of the habitat study proposed here is to describe the habitat use of macro and micro habitats by Colorado squawfish (*Ptychochelius lucius*) in the San Juan River. This study will use radio telemetry to determine habitat use in the San Juan River during summer with particular emphasis on locating spawning sites. The location of the spawning sites will be used to direct the placement of larval drift nets immediately downstream of the sites during spawning. Placement of those nets will be conducted under the larval drift task.

Methods:

The methods used in this study will be similar to those in previous habitat suitability studies. It will follow the procedures in Tyus (1988) and Wick and Hawkins (1989). We plan to use radio telemetry on fish that have been previously implanted during the adult monitoring research of the San Juan River Seven Year Research Plan. No additional fish will be captured or implanted during this study.

This study would monitor the fish for three weeks during the spawning season. It is most beneficial to gain the maximum amount of habitat use data during the spawning period. This study would have a sufficient number of observations on habitat usage to summarize the data with descriptive statistical techniques but probably not for any hypothesis testing. This study would provide additional information on location and use of specific habitat types within the river by squawfish.

Daily observations: An observation schedule will be completed before field data collection begins. Each day scheduled for observation will be divided into four observation periods. The observation periods will be for six hours each and be determined by sunrise and sunset times.

Observations will be made during morning and late afternoon/evening everyday of a scheduled observation week. A random selection process will be used to determine which fish will be observed during each period. That fish will be located and tracked for a two hour period. Any locations where the fish spends more than 30 minutes will be marked, and later measured for habitat variables. To gain data on habitat characteristics near the fish location, a detailed habitat map will be completed on overlays of aerial videography. This will allow some limited statistical testing of habitat usage.

The habitat usage data will include a sketch of the habitat where the fish is located with the position of the fish marked on the map. The data collected at the fish location will include date, time of day, weather conditions, time spent at each location, and any notes on movement during the observation period. The habitat data collected at each fish location will include total water depth, water velocity (mean column and bottom), substrate type, proximity to cover, description of cover at the location, general description of the site, measurements of the habitat type including length, width, bank features, shoreline vegetation, dominant substrate and cover for the habitat type. Other parameters measured will include water and ambient temperature, dissolved oxygen, conductivity, pH. Discharge will be obtained from the nearest USGS gaging station.

Data analysis: Data analysis will be completed in FY 1998 and FY 1999. All data analysis will be completed in conjunction with the winter habitat use study.

Report: A report for the study will be completed as part of the FY 1998 activities.

Personnel:

The study would be conducted by Miller Ecological Consultants, Inc. (Miller) with assistance, as available, from the other San Juan River Researchers. Miller would be responsible for all personnel and equipment to complete the study, with the exception being the fish that are radio tagged by the USFWS.

The principal investigator for the study will be Dr. William J. Miller. Dr. Miller will be responsible for final study design, directing the data collection and analysis, and the final report. Dr. Miller will be assisted on the study by a field biologist whose primary responsibilities will be leading the field crew gathering the habitat data and be responsible for data analysis. The field biologist will be assisted by one field technician. This crew with assistance from Dr. Miller will gather the habitat use data.

Costs:

The costs are listed in Table 1. The costs include the estimates for time and expenses for each study task. All costs for equipment and direct expenses are included in the cost estimate.

Table 1. Estimated costs for 1998 Colorado squawfish habitat use summer field work.

	Habitat Studies FY 1998 summer	
Labor	$	16,320.00
Travel	$	3,345.00
Equipment & supplies	$	2,100.00
Total	$	21,765.00

PROPOSAL TO DETERMINE ADULT COLORADO SQUAWFISH USE OF MACRO AND MICRO HABITAT TYPES DURING WINTER IN THE SAN JUAN RIVER.

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Introduction:

One part of the determination of limiting factors for Colorado squawfish (Ptychocheilus lucius) in the San Juan River is understanding the habitat requirements of that species. Habitat use studies, generally termed habitat utilization, have been an ongoing study component in the upper Colorado Basin (Tyus and McAda 1984; Wick and Hawkins 1989; Valdez et al. 1990). Habitat suitability work in the San Juan River has focused on the summer spawning period with only a brief period of winter observations (Miller 1994 and 1995).

The objective of the habitat study proposed here is to describe the habitat use by Colorado squawfish (*Ptychochelius lucius*) during winter in the San Juan River. This study will use radio telemetry to determine habitat use in the San Juan River. This study would be a multi-year study with one winter of observations during the usual winter releases from Navajo dam and one year during the proposed low flow releases. The study was originally proposed to start in winter of 1996/97 during the low flow release year pending implantation of fish. The scope of work was revised to address the stocking of adult fish in the upper San Juan River in fall of 1997.

Research Need: One element of the San Juan River Seven Year Research Plan is to determine the habitat requirements of the endangered species in the San Juan River. This includes the understanding of year round habitat use This relationship is critical in the recovery process for the endangered species. Understanding that relationship will help to determine if habitat is limiting the endangered species in the river and aid in the recommendations for year round flow releases.

Study Area: The study area for this work is the mainstem San Juan River between Navajo Dam and Lake Powell. The area which the radio tagged fish occupy most frequently is the reach from near Shiprock, New Mexico downstream to near Bluff, Utah. It is anticipated that the majority of the radio telemetry data will be acquired within this limited reach. This area is where most of the squawfish have been located in previous years and contains the reach of river that is thought to be used for spawning.

Methods:

The methods used in this study will be similar to those in previous habitat suitability studies. It will follow the procedures in Tyus (1988) and Wick and Hawkins (1989). We plan to use radio telemetry on fish that have been previously implanted during the adult monitoring research of the San Juan River Seven Year Research Plan. No additional fish will be captured or implanted during this study. Since the total number of fish is unknown at this time, this proposal has two options.

This study would monitor the fish for one week each month over a five month period during winter, November through March. This would encompass the winter flow period. The data set should have a sufficient number of observations to conduct statistical comparisons of habitat use and habitat availability to gain a better understanding of the winter habitat requirements of the San Juan River squawfish.

Scope of Work: The study will consist of radio tracking implanted fish to determine both the location within a reach of river and the habitat use by those fish. The radio tracking will be conducted for five consecutive days once per month for the duration of the study.

Field Work - General Approach:

Daily Observations: An observation schedule will be completed before field data collection begins. Each day scheduled for observation will be divided into four observation periods. The observation periods will be for six hours each and be determined by sunrise and sunset times. The two most important time periods are those near sunrise and sunset. Time periods will be numbered as follows: Period 1 - three hours before to three hours after sunrise; Period 2 - Three hours after sunrise to three hours before sunset; Period 3 - three hours before sunset to three hours after sunset; and Period 4 - three hours after sunset to three hours before sunrise.

Observations will be made during Periods 1 and 3 everyday of a scheduled observation week. A random selection process will be used to determine which fish will be observed during Period 1. That fish will be located and tracked for a two hour period. Any locations where the fish spends more than 30 minutes will be marked, and later measured for habitat variables.

Observations will be made during Period 2 based on a random selection by day and by fish number. Limited observations will be made during Period 4. Since the study time frame include the peak runoff period, the only observations made during Period 4 will be made at locations where the observers can safely move along the shoreline.

The habitat usage data will include a sketch of the habitat where the fish is located with the position of the fish marked on the map. The data collected at the fish location will include date, time of day, weather conditions, time spent at each location, and any notes on movement during the observation period. The habitat data collected at each fish location will include total water

depth, water velocity (mean column and bottom), substrate type, proximity to cover, description of cover at the location, general description of the site, measurements of the habitat type including length, width, bank features, shoreline vegetation, dominant substrate and cover for the habitat type. Other parameters measured will include water and ambient temperature, dissolved oxygen, conductivity, pH. Discharge will be obtained from the nearest USGS gaging station.

Data Analysis: All observation data sheets will be entered into microcomputer for summary analysis. Data will be entered after each weekly observation period. The data will be analyzed using a microcomputer statistical package. Procedures will include descriptive statistics of each habitat variable. Other exploratory statistical techniques will be run on the complete data set to determine if the habitat variables are independent or dependent components of the habitat.

Report: The final report for the study will include a detailed description of all methods used, data summary and analysis and, depending on the Option completed, a description of the habitat usage by Colorado squawfish. This report will be presented at the annual meeting of the San Juan River Researchers.

Relationship to other San Juan River Research: The habitat use studies are one element identified in the San Juan River Seven Year Research Plan. The habitat studies are listed as one component of the adult monitoring studies. As such there will be interaction between the adult monitoring studies and the Colorado squawfish habitat studies. There also is direct interaction required between the physical habitat studies and the Colorado squawfish habitat use studies. The habitat use information collected in this study and the physical habitat study information will aid in the determination of habitat-flow relationships for the river. The links to these other research elements will require integration of the research findings between the researchers.

Study Time Frame:

This study will most likely require multi-year data gathering to obtain sufficient habitat use information to complete a detailed statistical analysis. This study could start in late November and continue until late February The data analysis would begin after the field season is completed and continue until mid-October. The study results would be presented at the annual San Juan River Research meeting.

Personnel:

The study would be conducted by Miller Ecological Consultants, Inc. (Miller) with assistance, as available, from the other San Juan River Researchers. Miller would be responsible for all personnel and equipment to complete the study, with the exception being the fish that are radio tagged by the USFWS.

The principal investigator for the study will be Dr. William J. Miller. Dr. Miller will be responsible for final study design, directing the data collection and analysis, and the final report.

Dr. Miller will be assisted on the study by a field biologist whose primary responsibilities will be leading the field crew gathering the habitat data and be responsible for data analysis. The field biologist will be assisted by one field technician. This crew with assistance from Dr. Miller will gather the habitat use data.

Costs:

Estimated Costs for Winter Habitat Studies

Labor	$ 45,360.00
Travel	$ 9,800.00
Equipment & supplies	$ 3,450.00
Total	$ 58,610.00

Note: This project is on hold, pending adequate funding.

Literature Cited:

Miller, W. J. 1994. San Juan River Colorado Squawfish habitat use. 1993 Annual Report. Prepared for the San Juan River Recovery Implementation Program. Prepared By W.J. Miller & Associates. Fort Collins, Colorado. June 10, 1994.

Miller, W.J. 1995. San Juan River Colorado Squawfish habitat use. 1994 Annual Report. Prepared for the San Juan River Recovery Implementation Program. Prepared By Miller Ecological Consultants, Inc. Fort Collins, Colorado. June 15, 1995.

Rose, K.L. and D.R. Hann. 1989. Consolidated instream flow report: Habitat modeling on the Green River using the physical habitat simulation system. U.S. Fish and Wildlife Service, Upper Colorado River Basin Instream Flow Team, Grand Junction, CO.

Twedt, T.M. and P.B. Holden. 1980. The development of habitat suitability curves and estimation of available habitat for Colorado squawfish in the San Juan River, New Mexico and Utah. Bio/West, Inc., Logan, Utah.

Tyus, H.M 1988. Acquisition of habitat preference data by radiotelemetry. Pages 137-157 in K.D. Bovee and J.R. Zuboy, (eds.) Proceedings of a workshop on the development and evaluation of habitat suitability criteria. U.S. Fish and Wildlife Service, Biological Report 88(11).

Tyus, H.M. and C.W. McAda. 1984. Migration, movements and habitat preferences of Colorado squawfish, *Ptychochelius lucius*, in the Green, White and Yampa Rivers, Colorado and Utah. Southwestern Naturalist 29:289-299.

Valdez, R.A., P.B. Holden, T.B. Hardy. 1990. Habitat suitability index curves for humpback chub of the Upper Colorado River basin. Rivers 1(1):31-42.

Wick, E.J. and J.A. Hawkins. 1989. Colorado River Winter Habitat Study, Yampa River, Colorado. Final Report. Contribution 43 of the Larval Fish Laboratory, Dept. of Fish. and Wild. Biol., Colorado State University, Fort Collins, CO.

SAN JUAN HABITAT RESEARCH
1998 WORK PLAN

Keller-Bliesner Engineering / Ecosystems Research Institute
November 12, 1997

DATA INTEGRATION

Background:

Four subcommittees of the biology committee have been formed for the purpose of data integration and completion of flow recommendations. Keller-Bliesner Engineering and Ecosystems Research Institute Research Institute Research Institute are participants on each of these subcommittees. Tasks listed are those required for participation in the integration activities to meet the milestones of the Long Range Plan scheduled for 1997.

Objectives:

1.) Provide Hydrology/Geomorphology/Habitat Input to the Integration Process.

Methods:

1.) Analyze Hydrology/Geomorphology/Habitat Data in Relation to Biological Data Sets. (Continued Task) Inter-relationships between hydrology/geomorphology/habitat and data collected by other researchers will be analyzed. Those potential inter-relationships will be identified in committee.

2.) Participate in Committee Meetings to Review and Discuss Integration Issues. (Continued Task) It is assumed that 2-3 meetings of each subcommittee will be held to discuss results, integrate data and exchange ideas.

3.) Prepare assigned sections of the flow recommendation report. (New Task)

Budget (Funded by BIA)

Category	Cost
Labor	$64,440.00
Travel, per diem	$5,000.00
Vehicle/Equipment Use	$0.00
Supplies	$900.00
Overhead	$3,500.00
TOTAL:	$73,840.00

RIVER CHANNEL DYNAMICS

Background :

An understanding of river channel dynamics is the second step (after geomorphic characterization) in development of a river management plan. Understanding the history of channel change in relation to hydrologic events, precipitation patterns, construction of dams, etc. is important to the understanding of the system in which the endangered fishes have existed over the past 100 years as well an understanding of the effects of man's modification and conceptualization of the expected response of the channel to management changes in the future. Predictive modeling of river response to selected management actions allows formulation of a management plan to achieve desired objectives. Measurement of channel response to management actions during the research period allows determination of the empirical relationship of channel response to flow and calibration of any modeling efforts to predict effects of river management in the future.

In addition to measurement of cross section change, an understanding of the hydraulic conditions necessary to entrain (and thereby clean) cobble and gravel to prepare spawning sites and the transport mechanisms that are at work forming low velocity habitat suitable for y-o-y nursery are critical to the development of a river management plan to maximize these two important habitat types.

Data collection and preliminary analysis was initiated in 1992 and has continued through 1997.The basic data collection tasks will continue this year, with concentration on data interpretation and predictive analysis. Measurement sites have been modified to address long term change (base monitoring locations), specific response of spawning bars to flows to examine cobble transport mechanisms and analysis of backwater flushing during high flow.

Objectives:

1.) River Geometry Analysis. Determine short term and long term change in river cross sections at key locations.

2.) Suspended Sediment Analysis. Determine short term sediment transport and compare to long term record. Examine effect of various hydrographs on sediment transport.

3.) Cobble/Gravel Entrainment Analysis. Analyze cobble transport conditions at identified and potential spawning locations to determine flows required to form and maintain spawning bars.

4.) Analyze Mechanism of Low Velocity Habitat Formation. Analyze conditions necessary to develop and maintain persistent, high quality backwaters.

Methods:

1.) River Geometry Analysis. The 13 cross-sections surveyed in 1993-1996 will be surveyed pre- and post-runoff for analysis of annual change and compared to previous surveys to determine trends. The 10 cross sections established in 1994 in the key detail reaches (RM 0-15, RM 83-89 and RM 129-134) will continue to be surveyed as in 1997. Analysis of the change in cross-section geometry and substrate in relation to hydrographic conditions will be completed to provide data necessary for development of the system management plan.

2.) Suspended Sediment Analysis. The sediment data collection program initiated in 1992 will continue. Sediment data collected will be compared to long term data to determine validity of data and comparative effects of test hydrographs on sediment transport during the runoff period.

3.) Cobble/Gravel Entrainment Analysis. Potential spawning sites were identified in 1995. These sites as well as sites with similar characteristics were surveyed and modeled in 1996 and 1997. An additional survey will be completed in 1997 to characterize response of the sites to differing hydrologic conditions. Using data on substrate size distribution, the boundary shear stress required to entrain the size cobble encountered will be determined and plotted against the available shear stress to determine flow rate at which cobble and gravel sizes found in suspected spawning locations are entrained at these locations.

4.) Analyze Mechanism of Backwater Habitat Formation and Maintenance. In 1995 and 1996, backwaters that have persisted for more than 1 year and more than 2 years were identified and habitat quality parameters were measured. A representative sample of these persistent backwaters will be surveyed for a third year, along with the channel control necessary for their formation and maintenance and the hydraulics of the reaches characterized. Those conditions unique to these backwaters will be identified and the hydraulic conditions necessary to create and maintain them determined. A third backwater in reach 5 will be added to compare to response of the lower backwaters.

Budget (Funded by BIA):

Category	Cost
Labor	$103,440.00
Travel, per diem	$14,445.00
Vehicle/Equipment Use	$1,930.00
Supplies	$4,500.00
Overhead	$2,500.00
TOTAL:	$126,815.00

HABITAT MAPPING AND RESOURCE UTILIZATION

Background:

The documentation of habitat types within the San Juan River from RM 180 to RM 0 will be continued during FY97, although at a reduced scale. Sufficient data have been collected to develop habitat/flow relationships, with verification of stability with time and flow change. Since low velocity habitat seems to be the most variable in response to hydrographs, the fall base flow survey will be continued.

In 1997, the introduction and persistence of YOY squawfish necessitated mapping of habitat associated with the sampling locations. That activity will continue in 1998, mapping sampling during each sampling trip conducted.

Habitat utilization information collected during the squawfish radio tracking studies in 1994 and 1995 will be correlated with the habitat distribution data. In a similar manner, y-o-y captures will also be correlated with habitat data where possible.

Objectives:

1.) Main River Habitat Mapping. Map San Juan River habitat from RM 180 to RM 0 during September-October. This objective is a continuation of the 1997 work at a reduced scale.

2.) Digitize and process data utilizing GIS. Habitat mapping data will be digitized and entered into the ArcCAD system.

3.) Determine Habitat Quality. Process data collected in 1995-1996 and prepare report. This objective is the termination of 1996 work.

4.) Correlate Habitat Utilization to Availability. Correlate and compare detailed radio tracking data and y-o-y captures (habitat utilization) to habitat availability. This is a continuation of 1997 work.

5.) Verify Spawning Bar Conditions. Verify physical habitat conditions and complexities within the documented squawfish spawning bar and for other potential spawning locations. Utilizing data collected in 1995, 1996 and 1997, including identification of other locations exhibiting similar characteristics to the documented spawning bars, detailed sampling of the most comparable sites will be completed.

6.) Analyze Razorback Sucker Habitat Availability. Analyze potential Razorback habitat availability based upon habitat utilization from experimental stockings. Work will be closely correlated with the radio tracking data collection effort.

7.) Map Habitat Utilized by YOY Squawfish and Razorback Suckers. Characterize habitat during YOY sampling to determine habitat use vs. availability.

Methods:

1.) Habitat mapping (San Juan River and Colorado River). The documentation of habitat types within the San Juan River from RM 180 to RM-2 will be continued during FY98. One videographic flight will be mapped as part of this year's effort. Emphasis will be on fall base flow. Habitat mapping will be accomplished by directly delineating habitat boundaries in the field utilizing color prints from airborne videography taken a few days prior to the field investigation. Mapping methodologies (habitat types) will be the same as previous studies. Special emphasis will be placed on the Lake Powell/San Juan River interface. Processing of the data in the GIS system produces coded polygons for which the surface area is computed and stored individually. The surface areas of major habitat types (eg., riffle, run, slackwater, eddy, backwater, etc.) and an index of habitat complexity (Shannon-Weiner) will be summarized by river mile and geomorphic reach. Our objectives are to continue with a program designed to determine the spatial, temporal (base flow comparisons from year to year), and discharge-related variations in habitat abundance and complexity. The same process will be used for the YOY sampling analysis, except only the area in the vicinity of the sample will be mapped.

2.) Digitize and process data utilizing GIS. Upon completion of each habitat mapping program (Objectives 1 and 2), the field maps will be rectified and digitized into ArcCAD.

3.) Correlate Habitat Utilization to Availability. Detailed habitat maps will be developed for each radio tracked fish during each observation utilizing the most current aerial photos or videography. Habitat utilization will be compared with habitat availability utilizing ArcCAD.

4.) Verify Spawning Bar Conditions. Depending upon the hydrograph and the availability of radio tagged squawfish, physical habitat conditions (substrate size, depth to embeddedness, interstitial volumes and topography survey) within the spawning bar complex on the San Juan River will be measured. The cobble bars identified in 1995 as most similar to the spawning bars will be sampled in detail for quantitative comparison and assessment. This is ongoing work to document the change in conditions with time and hydrologic conditions. Consecutive surveys of the sites over three years will be used to assess the response of these bars to the hydrograph. With potential for spawning razorbacks, locations of spawning aggregations of razorbacks, if identified, will be assessed for conditions and response to the hydrograph.

5.) Analyze Razorback Sucker Habitat Availability. Razorback sucker habitat utilization will be determined by evaluating the habitat locations where radio-tagged fish are located based upon habitat preference data provided by other researchers.

Budget (Funded by BIA):

Category	Cost
Labor	$123,565.00
Travel, per diem	$6,450.00
Vehicle/Equipment Use	$1,000.00
Supplies	$3,000.00
Overhead	$9,113.00
TOTAL:	$143,128.00

FLOW/HABITAT MODELING

Background:

With the accumulation of two additional habitat mapping data sets for the entire river, preliminary model development begun in 1994 and continued in 1995, 1996 and 1997 will be updated. Relationships between geomorphology, habitat and hydrology will be incorporated into the overall modeling strategy. This will involve correlation of habitat distribution, abundance and complexity by reach with flow and geomorphology.

Objectives:

1.) Coordination and Review of Other Studies. Review other ongoing mapping and modeling projects within the Colorado River.

2.) Develop Habitat/Flow Relationships. Develop correlations between the distribution, abundance, and complexity of habitats in the San Juan River and flows by geomorphic reach.

3.) Incorporate Geomorphic/Flow Relationships by Reach. Incorporation of the hydrology/Geo-Graphics, Inc.-morphology relationships into the model developed under step two will be attempted to add predictive capability to the model.

4.) Develop Preliminary Management Strategies by Reach. Preliminary management strategies will be developed by reach as a first step in determining the flow requirements for the fish. These strategies will be refined and incorporated with flow/biological responses in determining the overall management strategy.

Methods:

1.) Coordination and Review of Other Studies. Interact with other researchers doing similar habitat mapping activities, and coordinate habitat types, definitions, and methodologies.

2.) Develop Habitat/Flow Relationships. Utilizing data files developed within ArcCAD, analyze the spatial distribution of habitat types within the San Juan River. Based upon the river segments where mapping and flows were constant, develop correlations between habitat abundance and complexity with flow. Hysteresis (pre- versus post-runoff habitat conditions) will be analyzed to determine year to year effects. Analyzes will be completed on a reach by reach basis for the reaches identified in 1994 and refined in 1995, 1996 and 1997.

3.) Incorporate Geomorphic/Flow Relationships by Reach. The geomorphology/flow relationships examined under river channel dynamics will be incorporated into the flow/habitat model on a reach by reach basis. The geomorphology of a reach will be compared to habitat complexity and availability to identify the function of the reach in supplying habitat and how that function relates to flow manipulation. Reaches exhibiting different geomorphology will respond to hydrograph manipulation differently. The relationships will be examined stochastically as well as statistically to identify the most appropriate modeling relationship.

4.) Develop Preliminary Management Strategies by Reach. The model developed under steps 2 and 3 will be utilized to analyze potential management strategies for each reach. Management of flow to maximize the most beneficial characteristics of a reach (e.g. spawning, Y-O-Y, or adult habitat, or a combination) will be examined and the resulting impacts to other uses and other reaches explored. The management strategies for each reach will be combined to examine cumulative affects and identify limitations to individual reach management plans. These preliminary management strategies are only the first step in developing the overall management strategy that considers impacts other than habitat. Initial strategies developed in 1996 will verified and refined in cooperation with the full team of researchers to incorporate results of all studies into the development of the recommended management strategy.

Budget (Funded by BIA):

Category	Cost
Labor	$51,370.00
Travel, per diem	$0.00
Vehicle/Equipment Use	$0.00
Supplies	$1,200.00
Overhead	$2,300.00
TOTAL:	$54,870.00

RIVER OPERATION MODELING

Background:

The USBR PRYSM river operation model is being used to model the river. Currently, the model is being calibrated and the simulation capability tested. The model is to be used to analyze the capability of the system to produce particular hydrographic conditions in the river below Navajo Dam. Assistance will be provided to USBR to review natural flows, calibrate the model and prepare for simulation runs on a weekly time step.

Objectives:

1.) Review Natural Flow Studies, Calibrate Model & Prepare for Simulation Runs. Natural flow studies presently being completed will be the basis for the model operation. A committee has been formed for review and verification of the results. The model is presently configured with a monthly time step and must be converted to weekly or daily.

2.) Complete Simulation Runs. Once configured, the model will be used to simulate reservoir operation to meet objectives defined in the research under various development scenarios.

Methods:

1.) Natural Flow Study Review, Model Calibration and Preparation for Simulation Runs. Results of the natural flow study to completed October 1997 will be reviewed and comments provided to USBR. Long term monthly natural flow at Bluff and Archuleta will be correlated to 1974-85 natural flow at other key sites in the basin and long term records at these sites generated using the correlation to the long term gages. Pseudo-daily and data will be generated from the monthly data utilizing long term daily gaged records for improved resolution of hydrograph shape. All data will be provided to USBR for inclusion in the model.

2.) Complete Simulation Runs. Utilizing the configured PRYSM model for the San Juan Basin, reservoir operation will be simulated to analyze the deliverability of flow requests and define future reservoir management rules.

Budget (Funded by BIA):

Category	Cost
Labor	$34,840.00
Travel, per diem	$5,000.00
Vehicle/Equipment Use	$0.00
Supplies	$1,000.00
Overhead	$500.00
TOTAL:	$41,340.00

WATER TEMPERATURE MONITORING

Background:

Water temperature recorders were installed in 1992. This work element is a continuation of the original work, with station servicing and data extraction.

Objective:

1.) Collect Water Temperature Data at 9 locations

Methods:

1.) Collect Water Temperature Data at 9 locations. Temperature recorders are installed at Cedar Hill and Farmington on the Animas, and at Blanco, Bloomfield, Lee Acres, Farmington, Four Corners and Montezuma Creek on the San Juan. These recorders will be serviced twice and the data extracted and plotted for the annual report.

Budget (Funded by BIA):

Category	Cost
Labor	$4,623.00
Travel, per diem	$270.00
Vehicle/Equipment Use	$200.00
Supplies	$200.00
Overhead	$0.00
TOTAL:	$5,293.00

GIS BASED INTEGRATED DATABASE MAINTENANCE

Background:

The GIS database developed in 1996 requires quarterly updating. This maintenance function is provided by this task. All updates will be coordinated through FWS-Region 2, the main repository for the data.

Budget (Funded by BIA):

Category	Cost
Labor	$23,264.00
Travel, per diem	$0.00
Vehicle/Equipment Use	$0.00
Supplies	$1,000.00
Overhead	$1,200.00
TOTAL:	$25,464.00

DEVELOP THE CONCEPTUAL FRAMEWORK TO DETERMINE POPULATION GOALS FOR THE SAN JUAN RIVER LONG RANGE PLAN

Principals: Ecosystem Research Institute, Inc. and Miller Ecological Consultants, Inc., USFWS Grand Junction (USFWS funded separately)

Objectives:

1.) Develop a conceptual model or models which will allow the evaluation of interim Management Objectives for the Endangered fish species and the native fish community in the San Juan river.

2.) Develop the mechanistic models to calculate population goals for 5.1.1; 5.1.2; 5.1.3

Relationship to recovery Program objectives and research need:

Meets the needs to complete milestones in Sections 5.1; 5.1.1; 5.1.2; 5.1.3.; 5.1.4 of the Long Range Plan.

The intent of this project is to estimate the carrying capacity of the San Juan River relative to population sizes of Colorado squawfish and razorback suckers. The approach to be taken will be a combination of ecological and population modeling, quantitative native fish population estimates, lower trophic level production estimates, and the transfer of upper basin ecological data (literature review).

This approach provides an explicit framework that documents the assumptions and basis for the population goals using empirical data from the San Juan and other Colorado River basin rivers for the endangered and native fish community. Further, the multiple modeling approach provides a method to verify and validate the population goals.

The modeling approach could be linked to the overall integration process for the San Juan River.

Methods:

The first task in this project will be to develop conceptual models from the fields of bioenergetics, habitat-based population response models, and logistic population growth models. Because of data limitations within each type of model (ie lack of respiration data on target species for bioenergetics or egg/yoy survivorship data needed for population modeling) a multi modeling approach will be undertaken. The goal will be to see convergence between model results upon application to the San Juan River.

Upon selection of the conceptual models and the evaluation of parameter inputs, a subcommittee will be established from members of the Biology Committee to provide direction and feed back

on the model development process and input parameters for the conceptual model. The entire biology committee will review the draft model reports.

Based upon a preliminary review of the available information within the San Juan and the knowledge about existing bioenergetic models, population estimates of the prey base (native species) for Colorado squawfish are needed. During 1998, population estimates will be made for the native fish community in the San Juan selected sub-reaches of three geomorphic reach 3, 4, and 5.

In addition, production and biomass estimates for primary producers (periphyton) and secondary consumers (macroinvertebrates) will be made on a monthly basis within riffles and runs for each of the three reaches where fish population estimates will be obtained. These lower trophic levels represent the food base for these native fishes. The data will be incorporated into the bioenergetics and habitat-based models.

An exhaustive literature review will be undertaken to specifically define population parameters of the rare fish needed for the population-based models. The literature review will also be undertaken to define the trophic interactions of the native species with the primary and secondary procedures (ie. food habits and food preference).

The results of this effort will be population dynamics of the T&E fish and native community based on population parameters derived from data obtained in the San Juan River and other Colorado Basin research efforts.

Budget (Funded by BIA):

Category	Cost
Labor	$89,000.00
Travel, per diem	$6,000.00
Vehicle/Equipment Use	$3,000.00
Supplies	$2,000.00
Overhead	$10,000.00
TOTAL:	$110,000.00

SAN JUAN RIVER BASIN HYDROLOGIC MODELING
OCTOBER 1997

U.S. Bureau of Reclamation

Description of the Work:

Reclamation's RiverWare framework model is being applied to the San Juan River Basin to provide detailed hydrology to support decisions in reoperation of Navajo Reservoir to enhance flows for the recovery, preservation and protection of the two endangered fish species and their habit; provide for continued development of the Navajo Indian Irrigation Project; and minimize impacts to as many uses as possible with the same water releases. For FY98, work will be completed on validation of the model configuration to mimic historic hydrology, calibration of a rule set that will mimic historic operations of reservoirs and stream compacts, and development of a fully derived rule set resulting from simulation runs with the baseline depletions.

Objective:

A primary objective of the study is to evaluate the effects on the river basin due to various operating scenarios and hydrologies. Basic river basin configuration, modeling, and a decision support systems that reflects existing river operations are being developed. These models were developed using RiverWare, a river basin modeling software tool. The San Juan River Modeling Workgroup has selected these models and software to conduct the fisheries analysis.

Background:

The San Juan River basin is the study area for a seven year study of the effect of reservoir and river operations on endangered fish species. The San Juan River basin has a number of management issues that are representative of the problems encountered in managing a watershed. Flow regulation alters sediment transport and changes channel morphology influencing the habitat of endangered and sport fisheries. Water-use problems are compounded by alteration in water quality (e.g. natural and man-induced increases in dissolved solids and trace metals from mine tailings). Lack of water complicates issues such as Indian water rights and irrigation return flows Waters of the San Juan River are regulated under the Colorado River Compact and total basin concerns effect water management in the San Juan basin.

Scope of Work:

The following will be preformed to evaluate the hydrology and develop the tools to evaluate various operational scenarios to meet the stated objectives in FY 1998:

1. Model Development
   - 1a. Finalize Natural Flow derivation with States of Colorado and New Mexico.
   - 1b. Finalize validation of the model configuration.

1c. Complete calibration of historic rule set.
1d. Develop baseline depletion data set.
1e. Extend 1970-1993 Natural Flow data set to the simulation period of study 1928-1993.
1f. Derive rule sets resulting from simulation runs with the 1928-1993 baseline level of depletions.

2. Review Draft Flow Recommendations
3. Provide support of RiverWare simulation runs for alternative analysis.
4. Document depletions database via GIS
5. Complete final report on hydrology and modeling.

Service Agreement with TSC - Dave King:

1. Software modification and maintenance - A number of pre-processors, utilities, and data management interfaces (DMI's) were developed to support the models. These may require periodic modifications and revisions.

2. Assistance in implementation of rules - Will work with area office and consultant personnel in implementing rules in PRSYM. Rules are the mathematical interpretation of existing and speculated reservoir and river operations. Mr. King will work with PRSYM developers on any modifications required to the rules system to support these analyses.

3. Technology transfer - Will provide training and other transfer of knowledge to area office and consultant personnel as required.

4. Participation in modeling team activities as required.

Tasks Budget:

WCS

TASK	TOTAL DAYS	COST
1a.	20	$10,000
1b.	5	$2,500
1c.	7	$3,500
1d.	8	$4,000
1e.	5	$2,500
1f.	5	$2,500
2.	23	$11,950
3.	43	$21,950
4.	70	$35,000
5.	33	$16,950
6.	20	$11,500
SUBTOTAL	239	$122,350
TRAVEL		$20,000
		$142,350

TSC Budgets:

Task	Time	1998 Co
1.	10 days	$7,120
2.	30 days	$21,360
3.	15 days	$10,680
4.	10 days	$7,120
Travel		$3,720
Total	65 days	$50,000
Grand Total		$192,350

Charges are to be divided as follows: 45% to Navajo Environmental Impact Studies; 45% to ALP Endangered Fish Studies, and 10% to Gallup-Navajo Project.
Portion charged to San Juan Recovery Program - $86,557

Summary of Data Generated:

- Historic basin man-caused river depletions
- Basin-wide Baseline depletions levels
- Hydrologic model of San Juan River Basin able to run:
  - Historic data
  - Base-line data
  - What-if scenarios
- GIS coverage of San Juan Basin agriculture lands identified by crop type, sub-basins, county-hucs and associated data